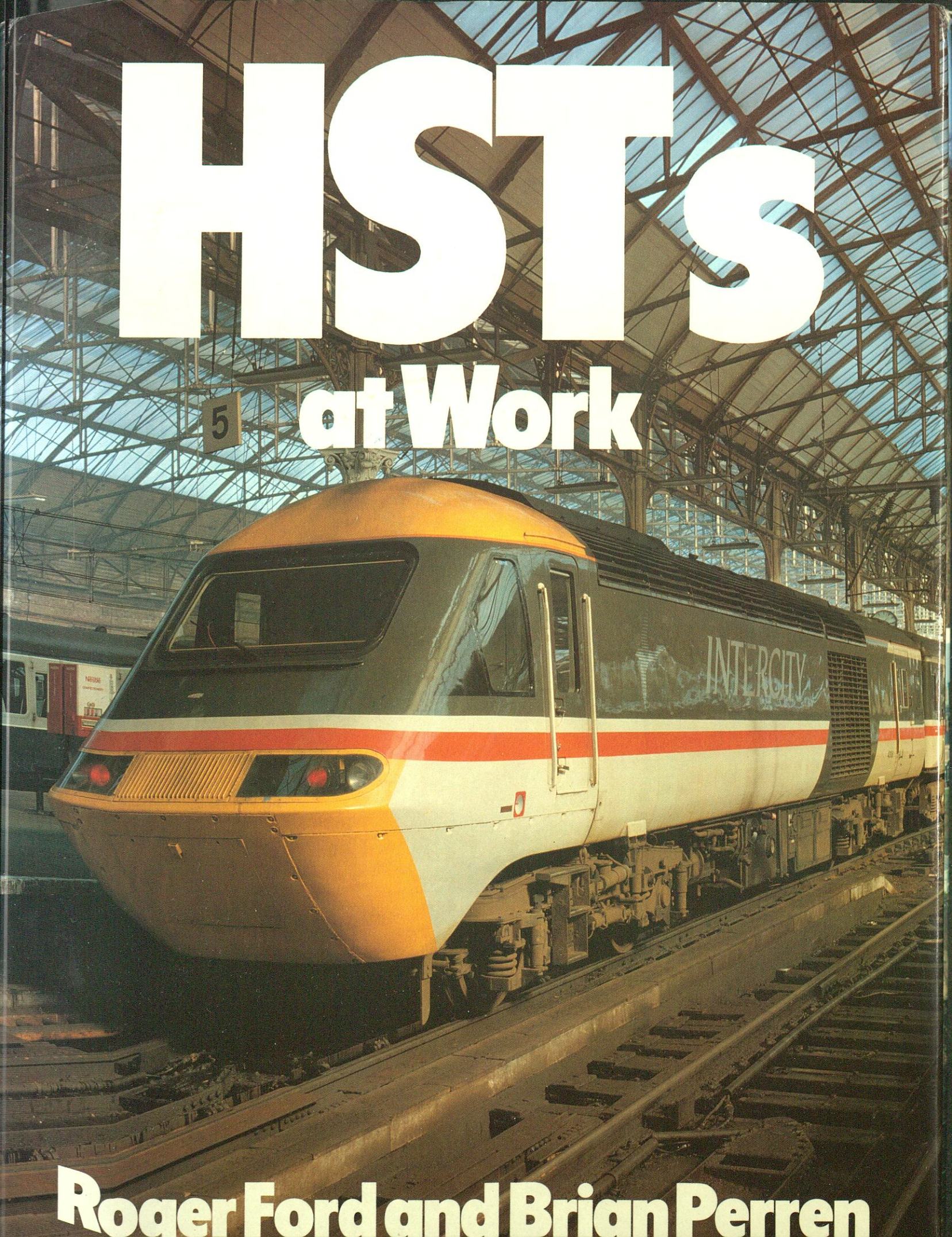
# HSTs at Work




Roger Ford and Brian Perren

# HSTs at Work

## ROGER FORD & BRIAN PERREN

The staggering success of British Rail's High Speed Train has revolutionised long-distance rail travel in Britain since it was first introduced to service in October 1976. Passengers at the time — paying no supplementary fare — could scarcely have imagined the speeds at which they were travelling, so smooth and quiet was the ride.

In this book, the latest in the popular 'at Work' series, Roger Ford and Brian Perren — two of Britain's most respected railway journalists — tell the story of the 'HST revolution', from the engineering work required to pave the way for 125mph running, through to the refurbishment programme and Pullman operations.

Drawing on their extensive knowledge, the authors present a fascinating insight into seldom-appreciated 'behind-the-scenes' activities such as cleaning, maintenance, timetable planning and, of course, the astonishing feats of diagramming which have squeezed every last ounce of utilisation from the HST in recent years. Every enthusiast dreams of riding in the cab of an HST, and in *HSTs at Work* the authors convey the excitement of an HST cab run whilst not forgetting to mention all those details which make today's HST performance possible.

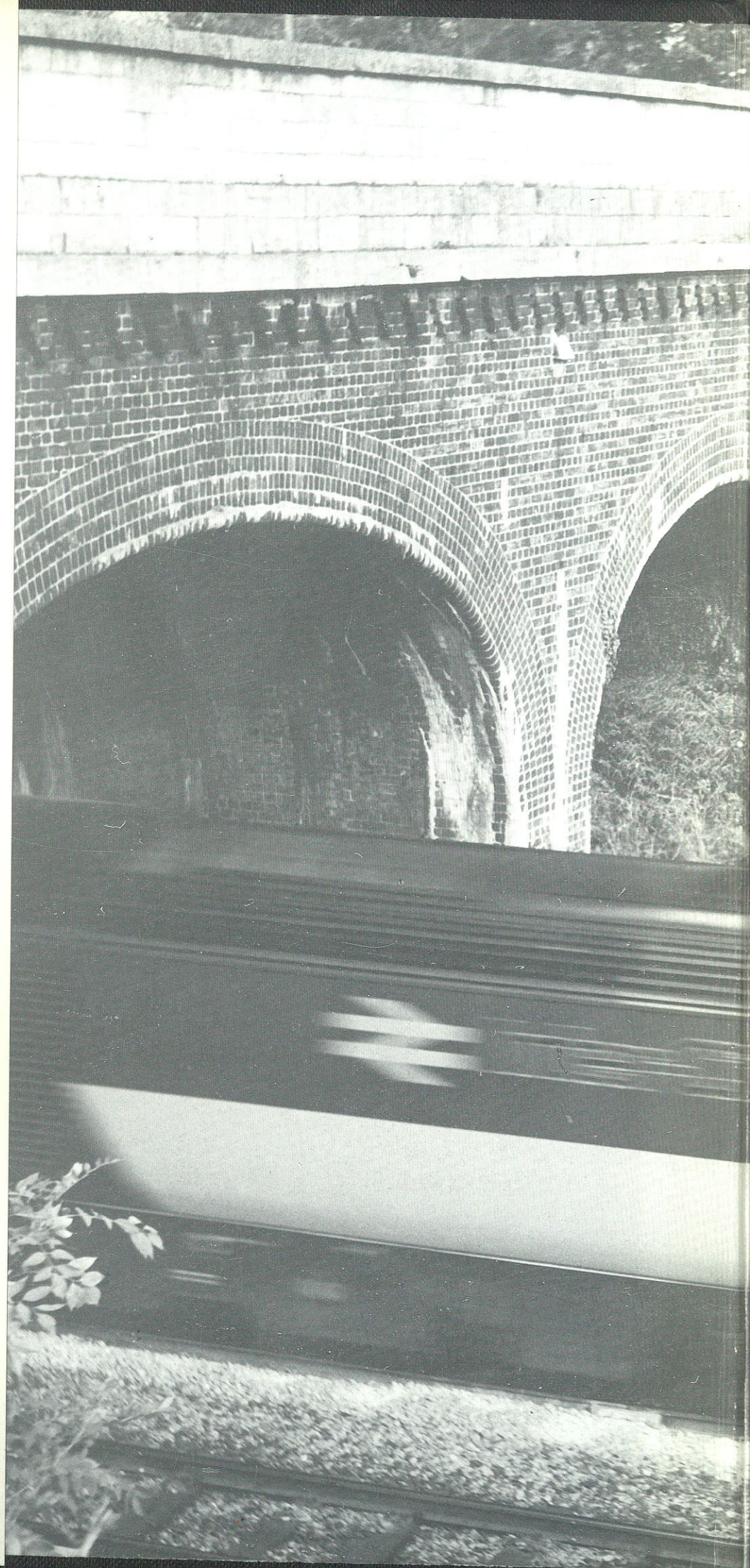
*HSTs at Work* presents a superb selection of photographs depicting the many facets of HST operation, and is destined to become the definitive work on these outstanding trains.

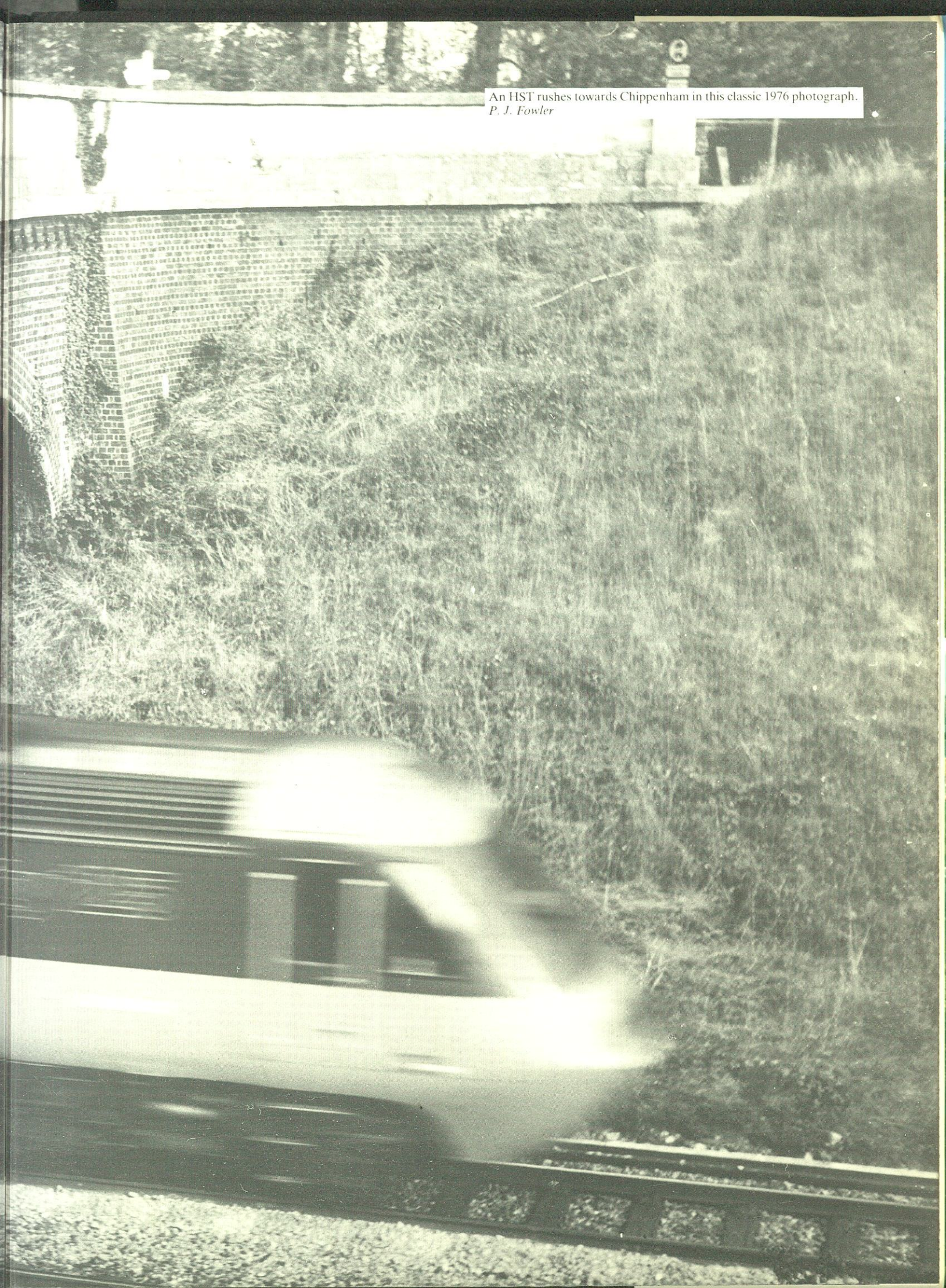
Front cover:
*Displaying the latest InterCity livery, complete with swallow emblem, HST power car No 43136 brings up the rear of the 15.36 to Plymouth at Manchester Piccadilly on 25 March 1988.* C. Wellum

Back cover, top:
*The 13.20 Newcastle-Plymouth bursts out of Milford tunnel, headed by No 43155, on 21 March 1987.* Graham Hudson

Back cover, bottom:
*Passing the few remaining semaphore signals at York Yard North is No 43109 powering a test train to Darlington. This train was run in connection with trials of the T4 passenger bogie.* Peter J. Robinson

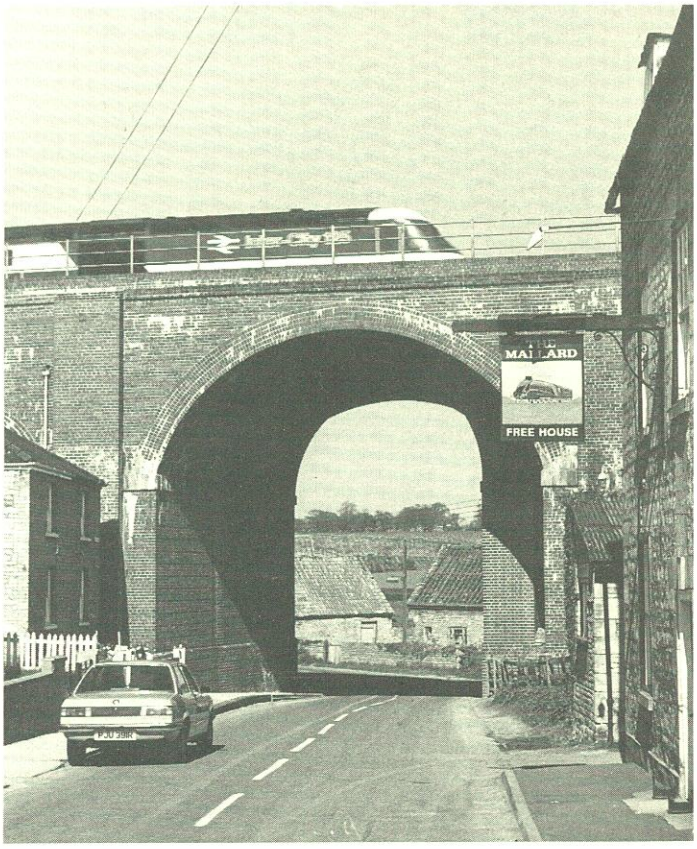
**£13.95**





An HST rushes towards Chippenham in this classic 1976 photograph.
*P. J. Fowler*

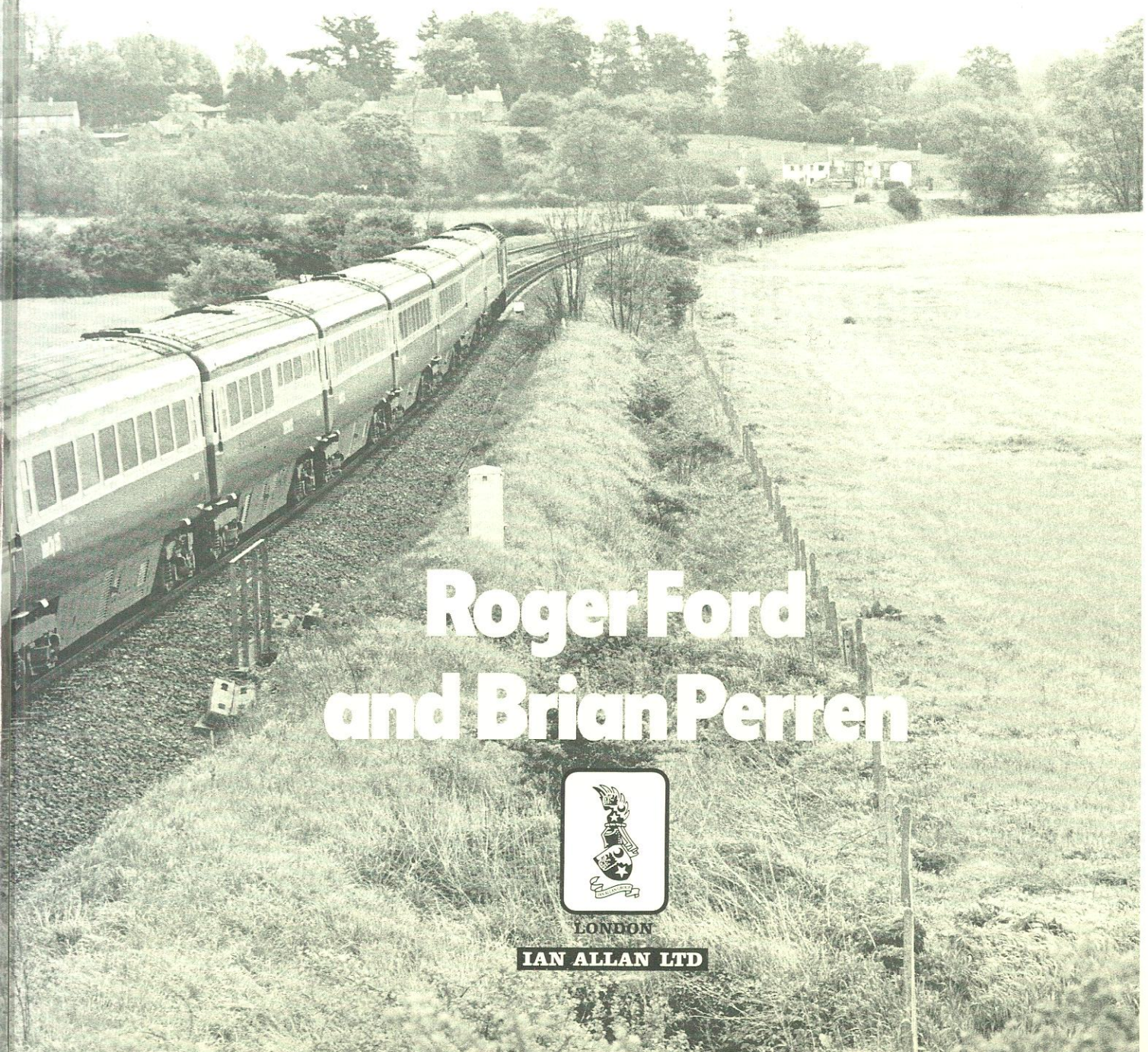
# HSTs at Work




High speed heritage — an HST passes Little Bytham, the point at which *Mallard* achieved her record-breaking run. *J. H. Cooper-Smith*

253 004
InterCity 125

# HSTs at Work



Roger Ford
and Brian Perren

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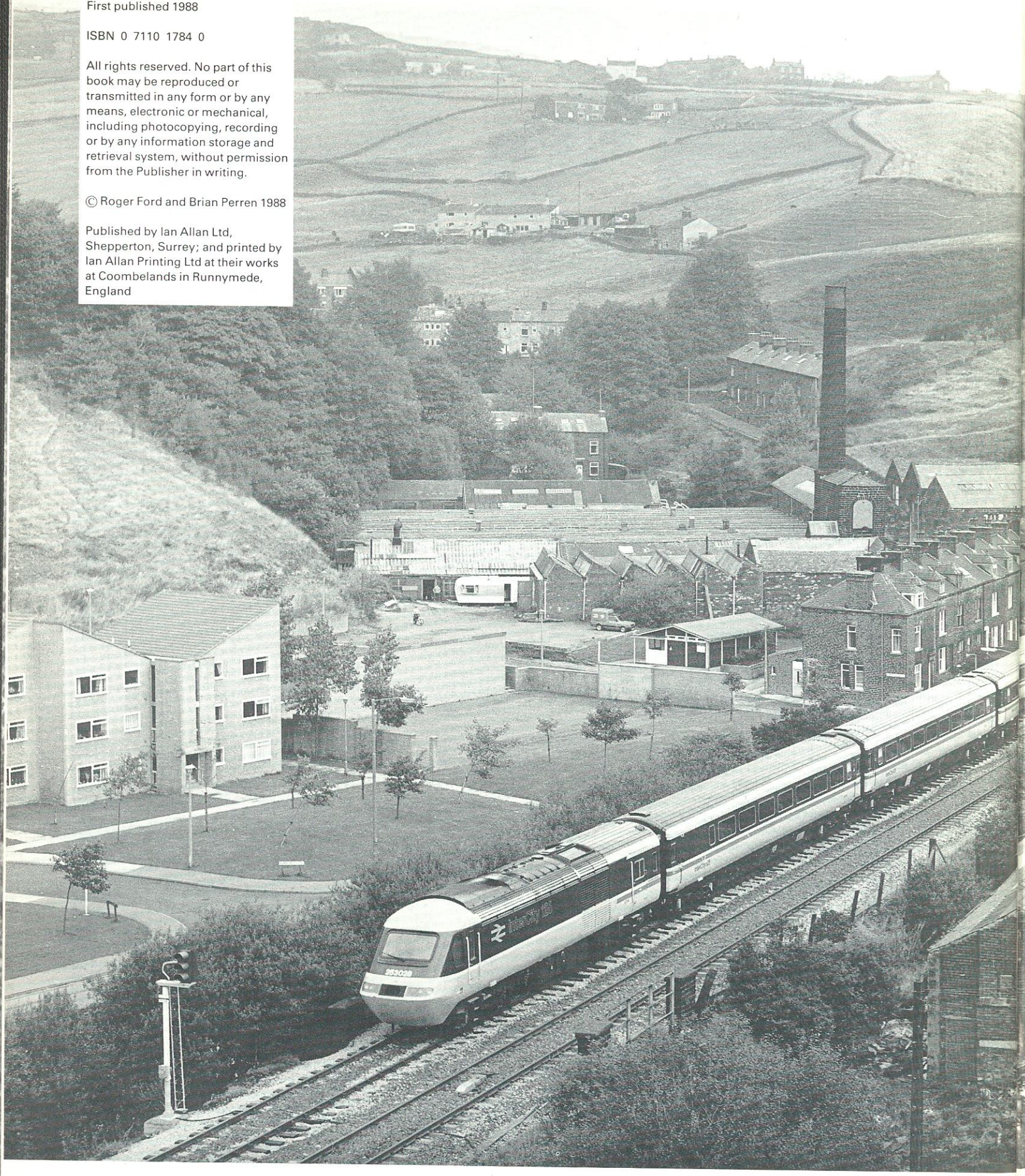

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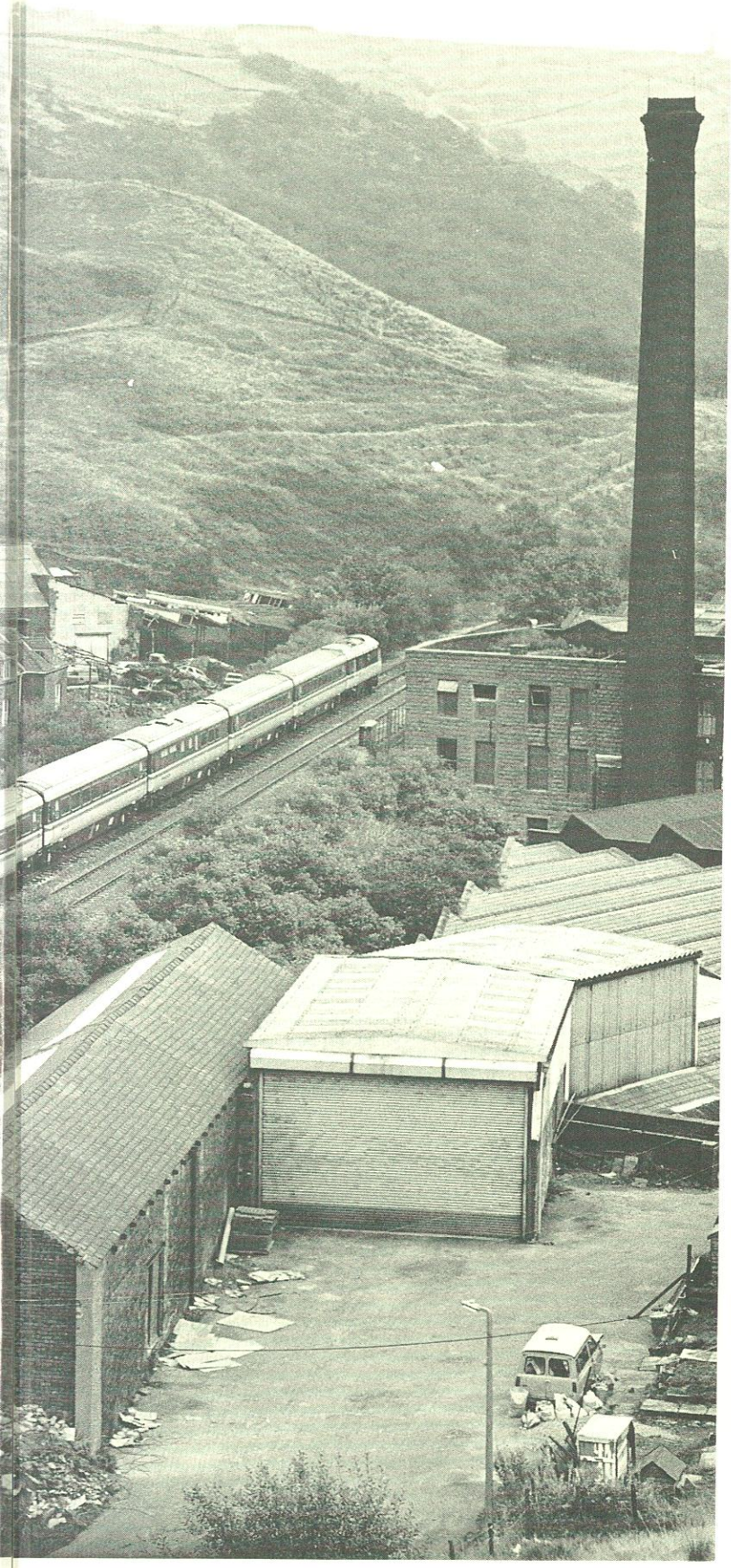


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*Previous page:*
The diverted 07.50 Plymouth-Newcastle provides the rare sight of an HST at Kings Sutton, north of Oxford. *W. A. Sharman*

*Left:*
Unit No 253.028 on the Todmorden-Burnley 'Copy Pit' line during promotional filming on 24 September 1983. *G. W. Morrison*

CHAPTER ONE

# A Train Is Born

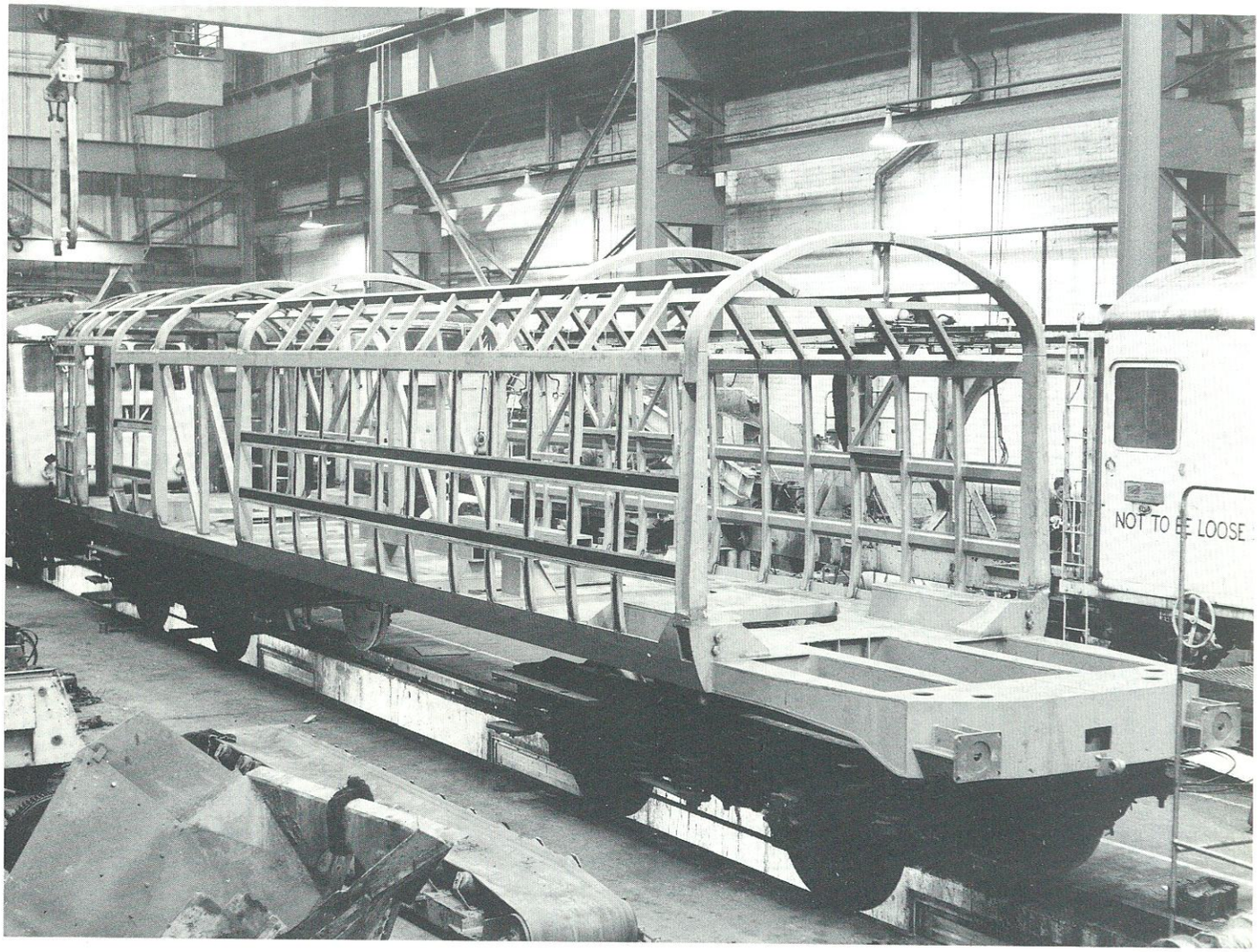
Not in response to a business specification and not at today's leisurely development time scales was the British Rail High Speed Train born. Forget the official record which claims that HST was a back-up to the Advanced Passenger Train (APT), part of a carefully thought out Inter-City strategy. That is just the organisation, with hindsight, bending history to fit today's reality. For the engineers who created HST, their train was a back-up only in the sense that they knew that APT was fatally flawed and believed that conventional technology was the right way forward for the next generation of Inter-City passenger trains.

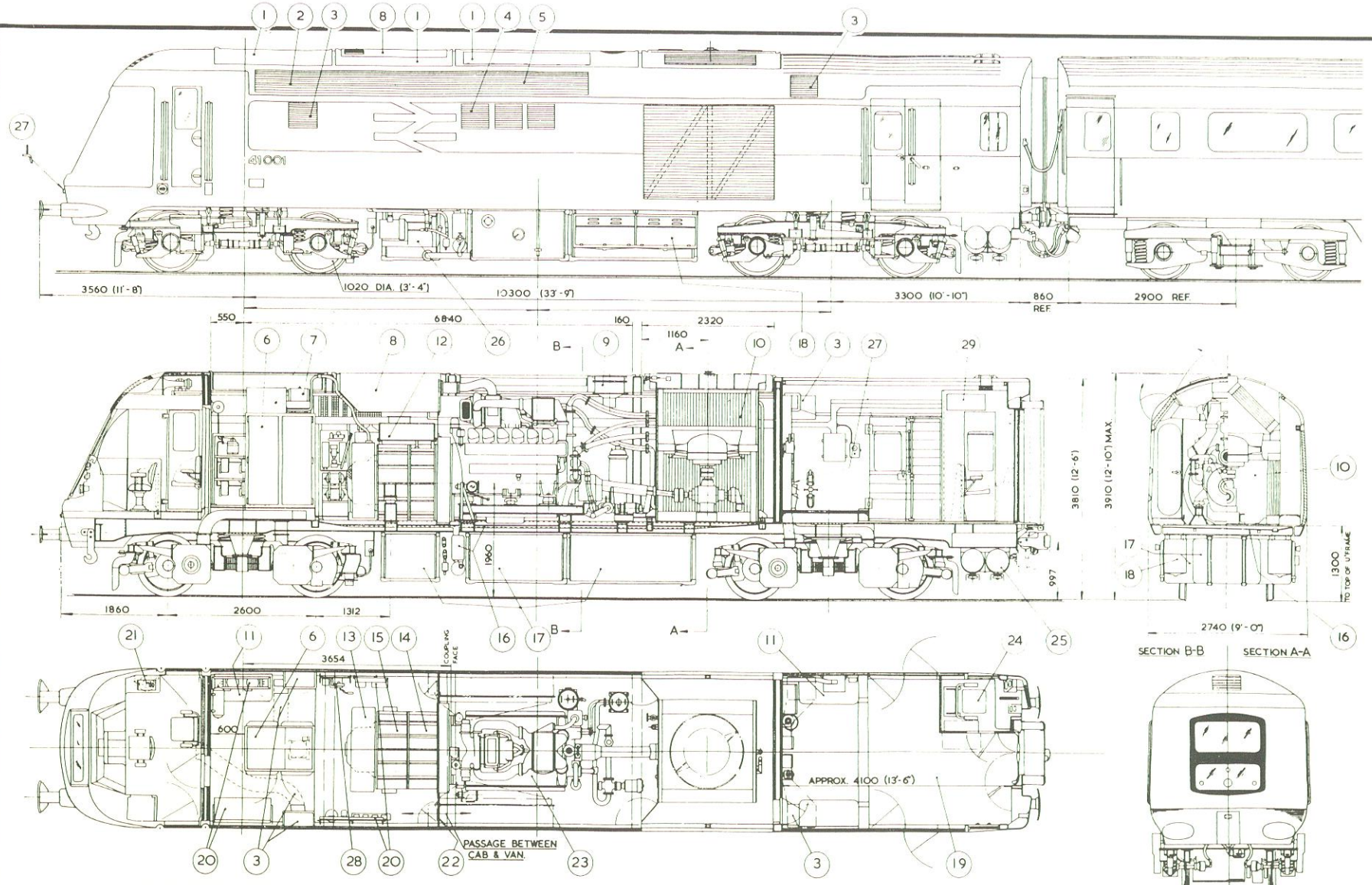
HST was conceived at a time of tension within the British Rail engineering hierarchy. Behind the tension was the challenge to the existing railway engineering organisation posed by the expanding Research Department. Following his appointment as Director of Research in 1962, Dr Sydney Jones had recruited a number of young engineers from outside the railway to staff the newly-built Railway Technical Centre at Derby. Legend has it that the new men were largely from the aircraft industry; some were, but many other engineering disciplines were represented.

What the young men who came to work for Dr Jones had in common was experience of state-of-the-art engineering in a variety of industries. They came to an industry whose mechanical and electrical engineers were already struggling with the bitter fruits of an ill-considered Modernisation Programme. Not surprisingly they were unimpressed by what they found. And, being young and full of confidence, they did not conceal their poor opinion of current railway technology from those in the existing BR engineering 'establishment'.

So long as Research was seen as a service organisation it could be ignored by the more reactionary among the traditional

*Below:*
One of the prototype HSDT power cars under construction at Crewe Works. *Colin J. Marsden*

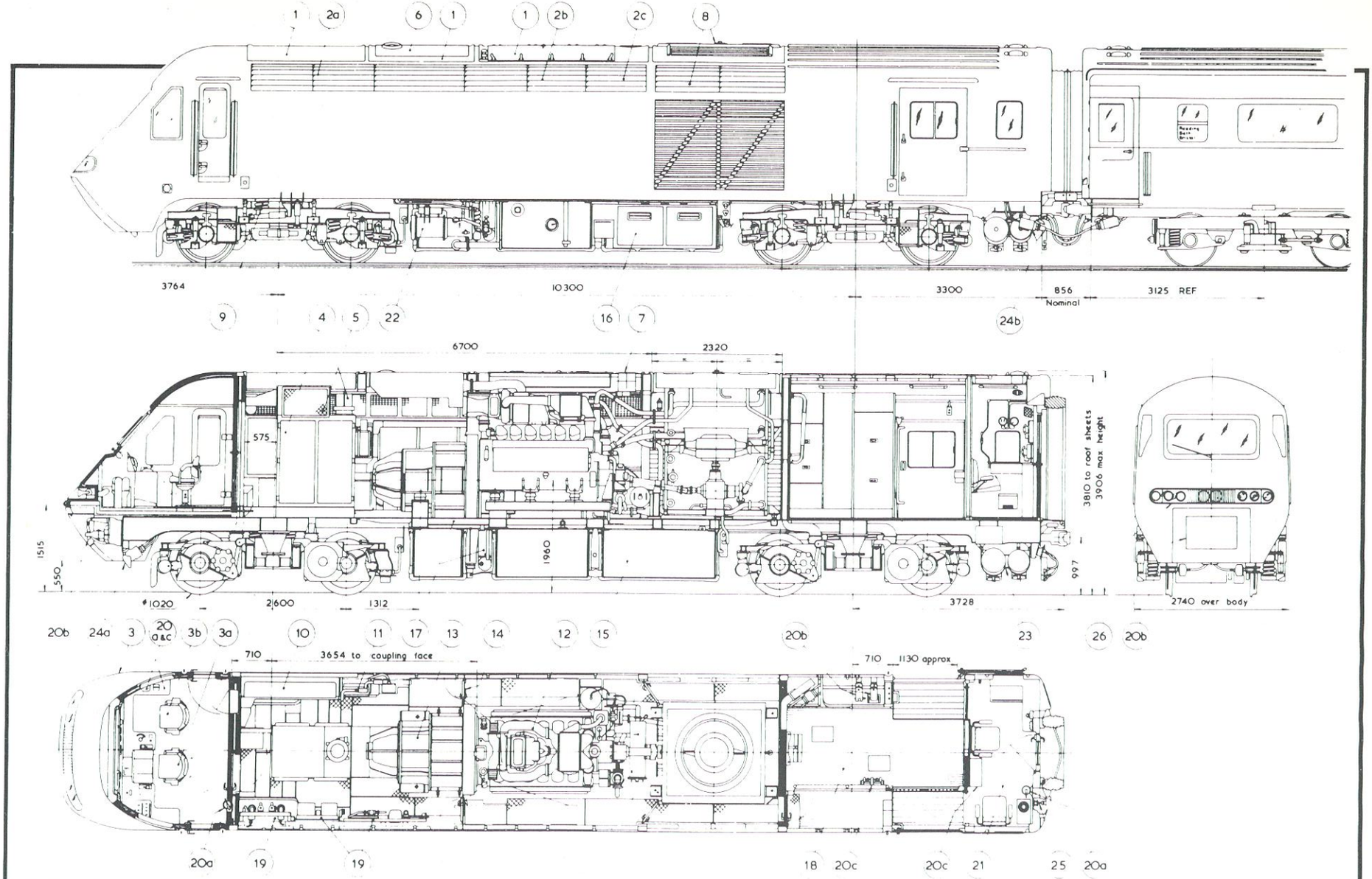





General arrangement of prototype HST power car.

**Key**

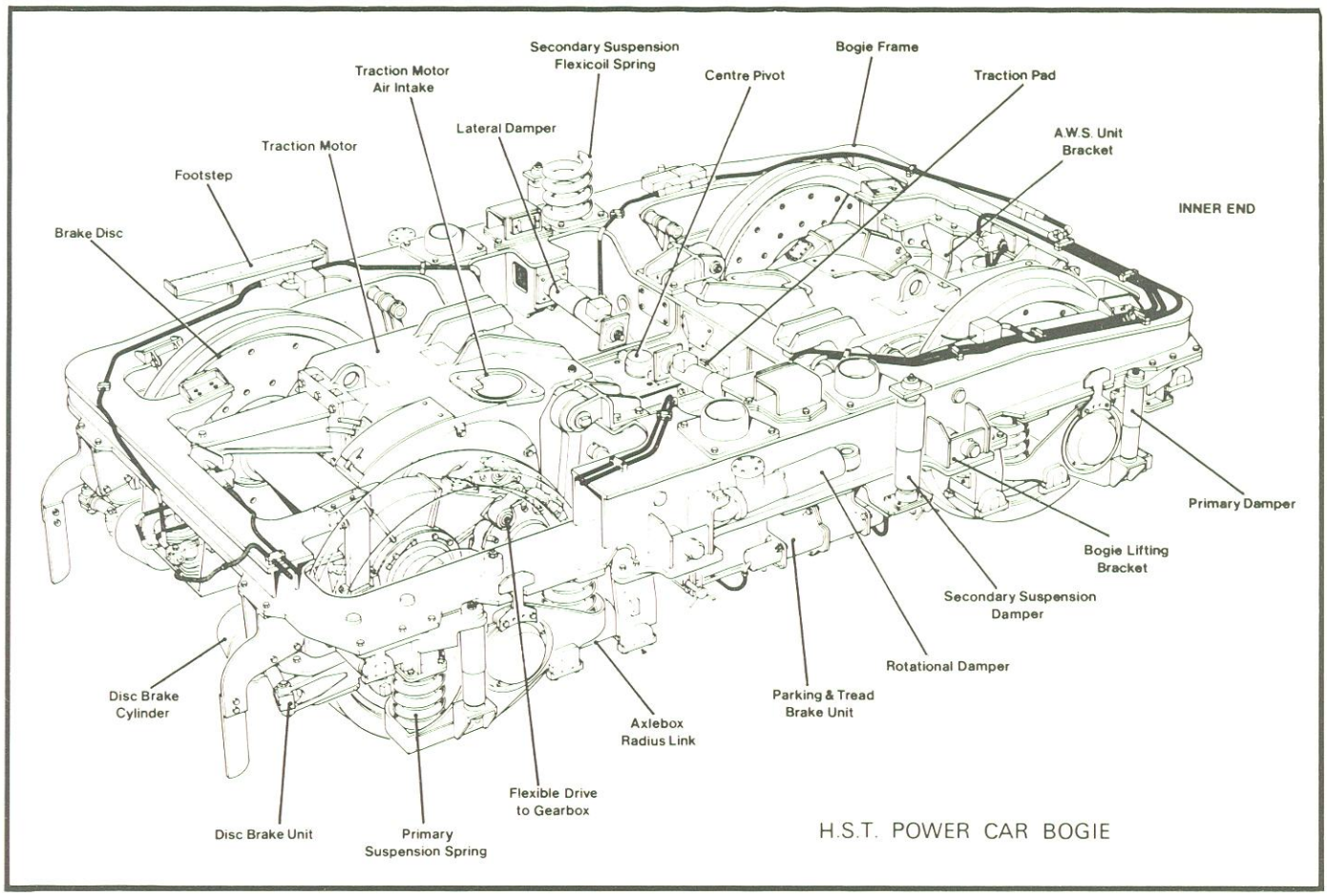
1. Translucent roof
2. Filtered air for ventilating interior and electric machines
3. Air for ventilating traction motors
4. Air for ventilating engine room
5. Filtered air for engine combustion
6. Electric equipment cubicle
7. Resistance unit and short circuiter
8. Silencer or ejector
9. Engine room ventilating fan
10. Radiator group
11. Flexicoil spring boxes
12. Train supply and auxiliary rectifiers
13. Exciter and traction rectifier
14. Train supply and auxiliary alternators
15. Traction alternator
16. Spillage tray and collecting tank
17. Fuel tank 5,500lit (1,250gal) maximum
18. Battery
19. Luggage accommodation (1 tonne)
20. Pneumatic and miscellaneous equipment
21. Fire equipment
22. Clean air compartment partition
23. Paxman Valenta engine 12 RP 200
24. Guard's and auxiliary driving position
25. Main reservoirs
26. Air compressor
27. Emergency equipment
28. Hydraulic stabling brake
29. Audio-navigator




**Power car layout as originally built.**

1. Translucent roof panels
2. Filtered air intakes for:
   a Electric m/cs & clean air compartment
   b Engine combustion
   c Engine room ventilation
3. Driving cab with:
   a Driving position
   b Assistant's seat
4. Electric control cubicle
5. Resistance unit & short circuiter
6. Silencer
7. Engine room fan
8. Cooling unit
9. Flexicoil suspension
10. Rectifier Unit
11. Battery charging unit
12. Paxman 'Valenta' Engine, 12 RP 200L
13. Alternators
14. Clean air compartment partition
15. Fuel tank, 5,680lt maximum
16. Battery box
17. Spillage tray & collecting tank
18. Luggage van, 1 tonne nominal
19. Brake & other pneumatic equipment
20. Emergency & safety equipment:
    a Fire extinguishers
    b Towing & propelling
    c First aid & safety
21. Guard's compartment
22. Air compressor
23. Main reservoirs
24. Train electric supplies, 415V, 3 phase:
    a Shore supply
    b Between cars
25. Parking brake
26. Horns & lights

BR Class 253
POWER CAR FOR
HIGH SPEED TRAIN




mechanical and electrical engineers and the fruits of its labours, for example in vehicle dynamics, accepted by the more enlightened. But the Advanced Passenger Train changed all that. In 1966, Dr Jones set up an Advanced Projects Group within Research to study new forms of passenger and freight rolling stock. Its fundamental task was to speed up the translation of the theoretical work being done in Research into revenue-earning hardware.

Once formed, the Group moved fast. In November 1966, it submitted a memorandum on a new design of high speed passenger vehicle to the BR Board. While the opening of the London-Liverpool/Manchester electrification earlier in the year had made railway managers once again aware of the commercial value of speed, there was more to the train proposed in the memorandum than simply speed — although the target of 150mph on existing track was impressive. To make this point 'High Speed' was replaced by 'Advanced', 'Passenger' was added to define its purpose, and the Advanced Passenger Train was on its way.

By November 1967, the basic concept of APT as a 150mph tilting train, able to transcend the limitations imposed by the existing railway infrastructure, had been developed in considerable detail. But the £4.83 million needed to proceed to prototype hardware was beyond BR's resources. Undaunted, Dr Sydney Jones went to Government and obtained the promise of 50% funding for the project if BR would provide the other half. In December 1968 it was announced that BR and the Ministry of Transport would fund the development of APT jointly. If all went well, the first production train could enter service in 1974.

While Research had been developing their train, the Mechanical & Electrical Engineering (M&EE) Department had not been idle. In the mid-1960s conceptual work had already begun on a new passenger coach to succeed the Mk 2, then entering service on the newly-electrified West Coast main line. Two design parameters were established early on; a service speed of 125mph and the ability to stop from this speed within existing signalling distances. That this work should be underway as the latest coach was only just entering service is an indication that the M&EE Department was far from reactionary. Although it was not apparent at the time, the traditional railway engineers were about to stage a comeback.

In the politics of railway technology, the M&EE Department was invariably overshadowed by Research because Dr Jones had a seat on the BR Board. In addition, the APT promised a complete train, whereas conventional technology was still concerned with vehicles. Also APT was very much in tune with the spirit of the 'swinging 60s'. But, in 1967, BR appointed a man called Walter Jowett as Director of Design. Although from outside BR, he came from English Electric Traction and was thus by upbringing, firmly from the mainstream of modern railway engineering.

One of Jowett's first tasks was to look at BR's traction requirements for the 1970s and the results of these studies were encapsulated in the first of the 'Black Books' titled *Locomotives for the 1970s*. As Director he also had regular dealings with Research. At one such meeting he disagreed publicly with the Research view that APT was the only way forward, and added that conventional railway technology could produce a 150mph train if required.

This sparked off the second 'Black Book'; *Diesel-electric multiple unit trains*. All the elements of what we know as InterCity 125 were in this far-sighted publication; the lightweight

Paxman Mk 3 Ventura (subsequently renamed 'Valenta'), ac/dc drive, standard coaches marshalled between two Bo-Bo power cars and disc braking. Only one difference stands out and that represents a tremendous opportunity missed. To match the 150mph operation of APT, the new train needed a total of 6,000hp which would also allow 10-coach trains to be hauled at 125mph schedules. This power would have been provided by the Vee 16-cylinder version of the Valenta.

Sadly, the engineer's vision was subsequently watered down and 125mph became the official target speed. Probably the lower speed was politically prudent, as it meant that HST would not be seen as competing with the 'official' way forward. But then others started looking at the new concept and queried whether such a train would ever need to run with more than seven coaches. For such a load, the 12-cylinder Valenta rated at 2,250hp would provide sufficient power for 125mph operation. Should additional capacity be needed the promised up-rating of the Valenta to 2,500hp would allow two power cars to handle an eight-coach train.

In mid-1968, a new Chief Engineer Traction & Rolling Stock was appointed. His name was Terry Miller and by training and experience he was likely to favour the High Speed Diesel Train concept. He had trained at Doncaster under Sir Nigel Gresley, the apostle of high speed fixed formation trains. As Chief Engineer of the Eastern Region of British Rail he had been responsible for the Class 55 'Deltic' fleet which was setting new standards for high-speed operation.

Trains can operate only as fast as the track and signalling allows. While APT was designed to transcend limitations, the new diesel train would be able to operate within existing restrictions without pushing technology. Fortunately, other aspects of railway engineering had been developing too. At a conference in Vienna on High Speed Railways, held in 1968, two important developments were announced by British Rail delegates. First, the civil engineers declared that their standard track of continuously welded rail on concrete sleepers was suitable for 125mph operation, provided certain limits on axle load and unsprung mass were observed. Second, it was announced that 125mph operation was acceptable with existing signalling and automatic warning system (AWS).

Thus, by the end of 1968 everything was coming together. The concept of the new train had firmed-up, the civil and signalling engineers would let it run at 125mph and the commercial departments, under pressure from the growing motorway network, wanted faster trains as soon as possible. The BR Board was also beginning to have doubts about the ambitious time-scales proposed for APT.

It was a case of perfect timing. At the January 1969 meeting of the BR Board, one of the items discussed was an assessment of what would happen if APT missed its targets. At the following Board meeting in February, Terry Miller and his team made their formal submission to develop the new Inter-City diesel train. It was a very detailed submission and promised a prototype 125mph train of six coaches and two power cars ready for testing just 22 months after authority to proceed was received. For good measure, the construction programme for the first 20 production trains was also shown.

The submission fell on fertile ground. At a function in March 1969 BR Chairman H. C. Johnson revealed the way the Board was thinking when he said, 'If the APT does not prove itself for four, five or six years, we cannot stand still and must go on improving track and trains on orthodox lines'. That is not to say that the project was authorised immediately but, while the Board considered its high-speed Inter-City strategy, the M&EE Department got on with the detail needed to flesh out the basic concept of what was becoming known as the High Speed Diesel Train (HSDT). The biggest step forward was the decision on the length of the Mk 3 coach, set at 75ft 4in (23m). A new bogie had to be developed, the BT10, with a stable ride at 125mph and above. Research drew on the dynamics work going into APT to assist with the development of the BT10 for the rival train. Manufacturers began development work on the key technical packages such as braking and wheel-slide detection systems and, in conjunction with the Admiralty, a 2,000-hour type test was carried out on a prototype Valenta 12-cylinder engine.

Then, in May 1970, the BRB Investment Committee authorised £70,000 for the development of what was called a prototype high-speed diesel-electric multiple unit train. In August, the Committee cancelled this decision and, instead, authorised the expenditure of £800,000 on the 'design, development and construction of a prototype High Speed Diesel Train of two 2,250hp power cars and six 75ft Mk III coaches'. Arguably, this was the most important decision taken by BR since nationalisation in 1948. Without HST it is doubtful whether the InterCity business, as we know it, could have survived the 1970s, let alone aspire to profitability by the end of the 1980s.

Meanwhile, the engineers had to deliver what they had promised and to a very tight timescale. While the design of the coach was well advanced, little had been done on the power car which had to pack a lot into a 68-tonne all-up weight on four axles. Today, the roll-out of the first Class 91 24 months after the contract was signed was considered a major achievement. The HSDT project team compressed a complete train into 22 months — with, let it be said, a running start. There were two other factors in favour of the HSDT. Rivalry between M&EE and the APT team was fierce and APT was already showing signs of what was to be its characteristic failing — programme slippage. For those designing HSDT this slippage opened up the alluring prospect of catching up APT-E. As one veteran engineer on the HSDT team recalls, there was no problem in getting people to work overtime. The lights in the design office burned late into the night because people wanted to get the job done.

The second advantage HSDT enjoyed was effective and imaginative project management. Learning from sometimes bitter experience, regular design review meetings were instituted, attended by all those involved in the design, manufacture and future operation of the production HSDT fleet. At these meetings, each department explained what it wanted or what it was trying to do. Other departments affected by, or responsible for, implementing these ambitions went away and at the next meeting approved the proposals or explained why their needs meant that there should be changes. As a result, much of the damaging 'design by hindsight' was avoided. No one could say that they did not know what they were getting or had not understood the implications of their actions. That this system did not bog down in an endless series of proposals and counter-proposals was due in part to the strong personalities of those leading the project team and also to the pressure of the 22-month timescale and the incentive to beat Research at their own game.

In the event, HSDT did not quite catch up APT-E, but it was a close-run thing. Research rolled out their train in May 1972, M&EE were ready a month later. However, once both trains were unveiled it was clear that HSDT had won hands down. Where APT-E really was experimental, its coaches full of test equipment, the HSDT was a true prototype, its coaches and catering vehicles fully equipped and ready to carry passengers in revenue-earning service. Where the next stage for APT would be

to build prototypes for service evaluation, HSDT was there already. Its next stage would be series production and squadron service. Not until 1974 would BR seek Government approval to build four prototype 14-car APT sets, planned to enter service in 1977. But by that service date, as we now know, HST would be introducing a new term to the vocabulary of railway marketing — 'nose cone effect' — verbal shorthand for the ability of the HST image to boost traffic by more than the immediate journey time reduction would be expected to produce.

Having achieved so much so quickly, the HSDT team found that it had been a case of hurry-up to wait. Both the new trains had cabs with a new layout. In place of the side-by-side seating for a driver and second man there was a single, central seat at the driving desk. The railway trades unions saw this as the thin end of the wedge on one-man operation and blacked both the HSDT and APT-E. So both trains sat at Derby and it was not until June 1973 that HSDT was able to start high speed trials.

Test running showed that the train performed better than predicted in the vital areas of going and stopping.

Acceleration from rest with a full train of seven vehicles on a slightly rising track gave an actual speed after 10.5 miles of 126mph compared with a predicted speed of 119.8mph. Equally impressive was the braking where the 9%g (g=the force of gravity) deceleration was achieved on dry and wet rail. As already mentioned, the ability to stop within existing signalling distances calculated for 100mph trains was the fundamental requirement for successful HSDT operation. The 9%g obtained gave a braking distance of 1,930yd from 125mph compared with the 2,220yd permitted for a conventional train to brake from 100mph. Thus not only did HSDT meet the specification, but there was distance in hand to allow for repeated application of wheel-slide protection equipment under low-adhesion conditions.

Ride of the passenger vehicles and power cars was also evaluated. Nowadays, ride is evaluated in terms of the lateral and vertical accelerations experienced by the passenger, but in the 1970s the yardstick was 'ride index' based on a scale from 1 to 5. At 130mph, the Mk 3 coach gave a ride index of 3.2 — near the limit for passenger vehicles. However, this was not reflected in passenger reactions which rated the ride at that speed as 'good'. This was attributed to the low noise levels in the air-sprung coaches which set new standards on British Rail for ambience.

Power car ride experience was not so satisfactory. During the initial high speed testing, despite vibrational tests having been carried out by Research in the APT Test Hall before trial running began, severe bogie hunting was experienced at 128mph. To combat this the dampers controlling the bogies' lateral and rotational movement were made stiffer and the flexible mountings between the traction motors and the bogie frame removed. New high speed tests showed that the bogies ran up to 143mph without hunting.

The year lost to industrial action meant that trial running before the design of the production trains was 'frozen' was severely curtailed. Between 1973 and the production trains entering service on the Western Region in 1976, the HSDT would run just 180,000 miles, much of the time operating within the constraints of the existing 100mph railway. When reading the later chapter on service experience with the production fleet, those who wonder why unforeseen difficulties emerged despite prototype testing might consider that the total mileage accumulated by the HSDT over a three-year period is today achieved in only 41 weeks by each train in the HST fleet.

*Below:*
The first HSDT power car shortly after completion. Note the conventional buffers and absence of side windows. *Colin J. Marsden*

Some lessons were learned from the HSDT. One was that under heavy braking the smell of hot pads could enter the passenger compartments through the air-inlet ducts of the air-conditioning system. The modification was to fit a system which closed the inlets when a brake application above a certain level was made. This was the start of the longest-running of all HST problems. What the proposed modification failed to take into account was that so long as the train was moving, the smell from the brakes was left in the slipstream. The smell became a serious problem only when the train had stopped (and the inlets reopened), and sat there with its heavily-used disc brake pads cooking gently, surrounded by a stagnant mass of fume-laden air. One manufacturer was to try over 70 different brake pad formulations to try and defeat this problem which is still common to all BR disc-braked stock.

Ideally, changes made as a result of the lessons learned from the HSDT should have been tried out on the prototype before being incorporated into the production trains, but, as ever, time was not on the engineers' side. At its inception, HSDT had been a classic example of technology push. Now that it existed, the situation had changed to one of market-pull. The BR commercial officers wanted 125mph trains and it wanted them as soon as possible. As a result, engineering judgement came into play and some features had to be introduced before they were fully proven.

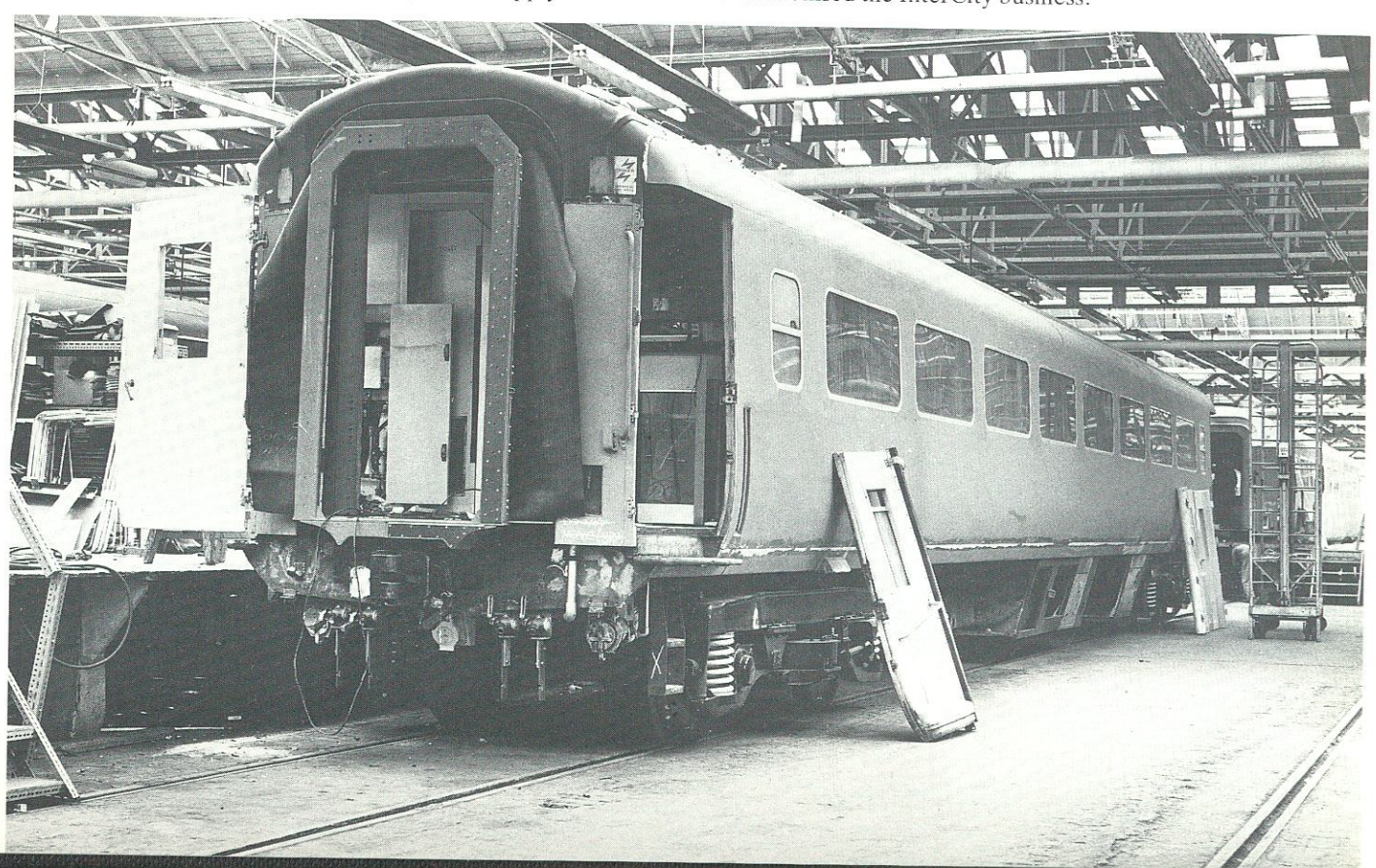
Changes were made to the power cars and passenger vehicles including increasing the size of the radiators as a result of trial experience. Another important change was in the supply of auxiliary power to the train. British Rail locomotive-hauled coaching stock is designed to operate with a 800-1,000V dc power supply from the locomotive for heating, lighting and other services. The dc is used 'raw' for heating, but has to be converted to 415V ac to drive air-conditioning equipment, lighting and kitchen car equipment. With the adoption of a brushless alternator for the HST, it made sense to generate electric power for train services by an auxiliary alternator on the end of the main traction alternator shaft, and eliminate the weight and poor reliability of the motor alternator sets which convert dc to ac on the standard Mk 3 coach.

As the speed of the diesel engine varies with the power demanded by the driver, the frequency of the supply also varies. By ensuring that the ratio of voltage to frequency is always the same, the squirrel-cage motors which drive air compressors and other equipment do not notice the changing supply. This system has undoubtedly contributed to the reliability of HST, but it has also meant that in an emergency standard loco-hauled Mk 3 coaches cannot be marshalled in an HST set.

For the traveller, the most dramatic change was the restyling of the power car nose, where Industrial Designer Kenneth Grange achieved a shape which was at once aerodynamically efficient and aesthetically timeless. Moving the second man's position to beside the driver meant enlarging the windscreen, and side windows were also incorporated. All this extra glass meant that full air-conditioning had to be introduced to cope with solar heat gain in summer. A particularly clean nose-end was achieved by replacing the traditional buffers and drawgear with provision for a central drawbar to which a coupling bar could be connected, should it be necessary to haul a HST in an emergency. Any of those who had to use this system in future years would gladly have put up with the visual intrusion of buffers on that classic front end.

Inside the power car, an extra 1ft of luggage space was found by moving the radiator group closer to the engine and a flat floor was provided. The guard's accommodation in the power car was also improved. With hindsight, we know that BR subsequently moved the guard into the first passenger coach, partly because of the harsh ride and because the creature comforts of the cab were not matched at the back of the power car.

It is worth noting some key dates which illustrate the continuing pressure as the new train went from prototype to series production. Design of the production trains was completed by April 1974. It was not until May 1975 (after five months of test running on the Western Region routes to be HST-operated) that the prototype HSDT could be spared for revenue-earning service, running 750 miles a day between London, Bristol and Weston-super-Mare. The first power car was completed at Crewe Works in October of the same year, and the first set entered service on the Western Region, running to existing timings, in August 1976. Then, on 6 October 1976, the world's first 125mph diesel-power passenger service started. In just six years and two months British Rail's engineers had revolutionised the InterCity business.



*Facing page, bottom:*
HSDT trailer cars were subsequently modified to production HST configuration. This view of work in progress at Derby shows the alterations to vehicle end and side. *Colin J. Marsden*

*Top left:*
Pinched fingers and straining muscles as the unpopular emergency bar coupler is prepared for No 47292 to assist failed power car No 43092.
*Derek Porter*
*(via Colin J. Marsden)*

*Above:*
This view of an uncompleted trailer second vehicle at Derby shows the under-vehicle equipment space normally covered by skirts.
*Colin J. Marsden*

*Left:*
What might have been — one of the BREL-built Mk 3 coaches for Eire fitted with power-operated plug doors. *Roger Ford*

*Left:*
Because of the electrical load of on-board equipment, terminal stations were fitted with electric shore supply points to reduce the drain on batteries during turn-rounds, and reduce in-station engine pollution.
*Colin J. Marsden*

*Below:*
First out — pioneer production set No 253.001 passes West Drayton in November 1982 on a Plymouth-Paddington service.
*Colin J. Marsden*

The prototype HSDT just after passing Cholsey & Moulsford in February 1975. Buffers, deleted from the production machines, were to make a comeback 12 years later when HST power cars were converted for push-pull operation as driving van trailers (DVTs) with electric locomotives. *Philip D. Hawkins*

Towbar in place, a Class 47 hauls a failed HST set on a Plymouth-Paddington service. *Michael J. Collins*

*Inset:*
Seen at Crewe Works in 1975 is the massive glass-reinforced plastics cab, moulded in one piece. *Peter G. Lymer*

CHAPTER TWO

# Preparing The Way

Design and production of the prototype High Speed Train in such a short time was a tremendous achievement for British Rail's mechanical and electrical engineers, but this was only the first part of the HST story. Raising the maximum potential speed for passenger trains from 100 to 125mph on the main trunk routes posed an equally difficult challenge for both the civil and signalling engineers. Their first task was to identify those parts of the route which could be readily upgraded to 125mph together with other locations where an increase in line speed would contribute to journey time reductions. To achieve significant time savings the sections of track authorised for 125mph must be as long as possible, preferably without any break in continuity imposed by an intermediate lower speed restriction. A case in point was the long-standing 25mph speed restriction through the dog-leg curve at Peterborough on the East Coast route, which interrupted the continuity of two long sections of 80-100mph route.

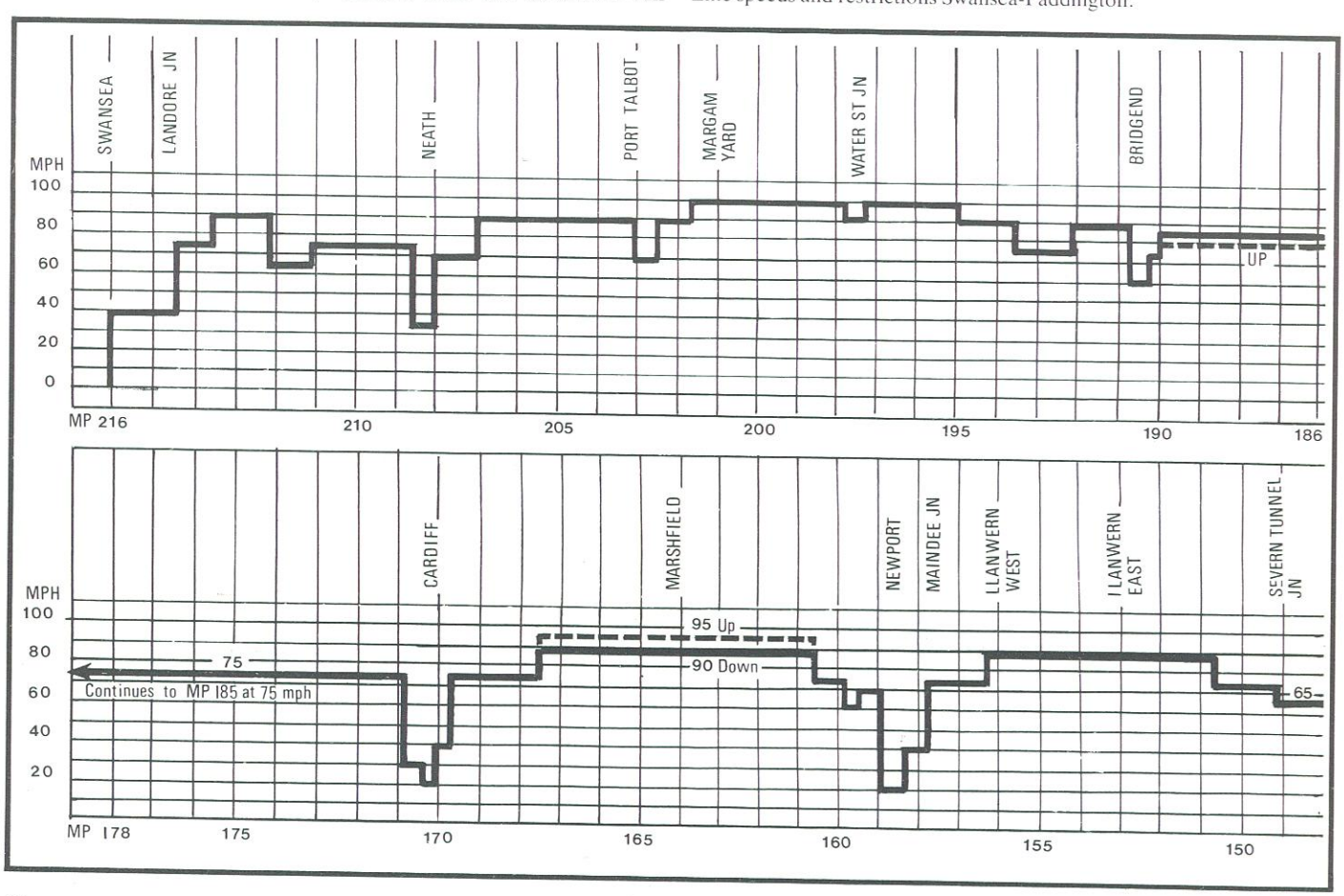
While sustained high speeds are important, valuable minutes can also be gained by judicious upgrading in the lower speed bands. Exits and entrances to large terminal stations provide such an opportunity to the engineers. If curves can be eased out and cross-overs repositioned, so that the line speed can match the acceleration of the train, valuable time can be saved. An example was the 15mph restriction out of the platforms at King's Cross which could be raised to 30mph for those platforms with a direct alignment into the tunnels.

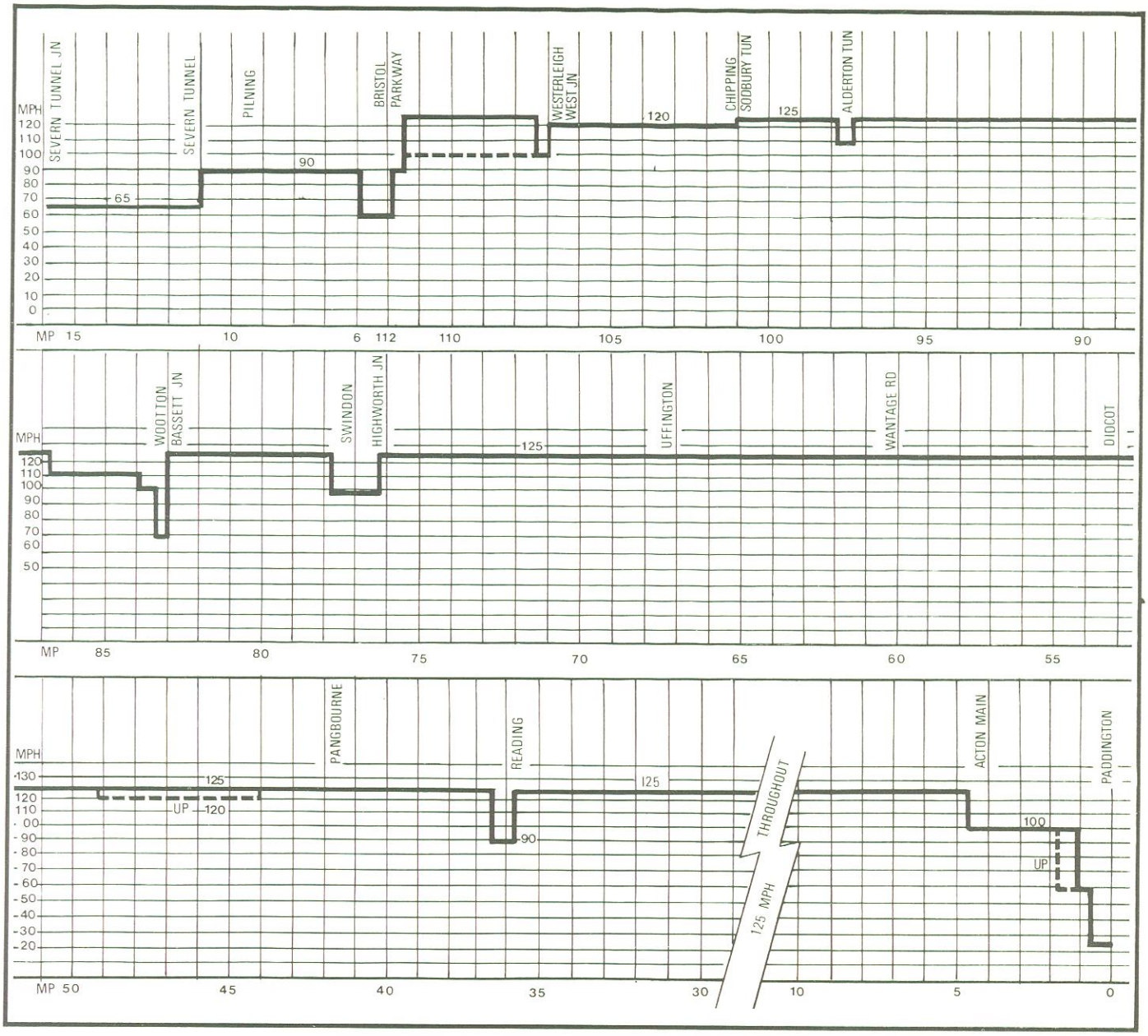
Because of the way the HST story unfolds, it would be helpful to consider the speed characteristics of the main routes at this stage in the narrative.

## London (Paddington)-Bristol/South Wales

The Western Region began preparing the track for 125mph services in 1972. For the region's civil engineering staff it meant a massive appraisal of the condition of their permanent way. On both initial HST routes — Paddington-Bristol/South Wales — the overall situation was similar. Between Paddington and Box Tunnel and Bristol Parkway, the alignments and gradients were ideal for 125mph running. From these points on, improvements were difficult, taking into account existing speed restrictions. The first requirement was to determine the condition of the existing trackbed — and the ballast in particular. This was achieved by digging 18in-square trial holes 15-18in deep every

*Below and above right:*
Line speeds and restrictions Swansea-Paddington.






10 chains. It was the first major survey of its kind since the line was built and in places the results were not encouraging. In many places the ballast had consolidated with the underlying soil to form a compacted mass leaving a layer of effective ballast perhaps only 4-6in deep compared with the required 12in minimum. This stemmed partly from the speed with which the Region had installed its early continuously-welded rail. The drive to get the new rail down had meant that it was laid on the existing bed without the extensive reballasting which was a later feature of such upgrading.

Depending on the severity of the problem, the civil engineer had three ways of bringing the trackbed up to standard — and for HST running it is a very high standard indeed. The easiest, in work terms, is to lift the track 12in and lay good ballast beneath it. This is a simple solution if clearances to overhead structures permit, but less than ideal, in civil engineering terms, because it destroys the cesses at the side of the track and interferes with drainage. The more usual solution is to use the standard ballast-cleaning machine to excavate 12in below the sleepers and relay the bed with new ballast.

Drainage is a major preoccupation of the permanent-way engineer. If water drains through the ballast and gets into the underlying soil, the vibration of passing traffic can cause a slurry to form, which consolidates the ballast or makes it 'sticky', impairing its function. To improve drainage of reballasted track, BR modified its ballast-cleaning machinery so that a bitumen-based compound is sprayed on the formation after the ballast has been excavated. This forms a waterproof layer and, as the formation is graded to one side, the water runs off into the cesses. Only a simple modification is required — a spray-bar on the excavator connected to a tank of bitumen. The severest remedy, blanketing, is reserved for locations where the underlying strata are particularly difficult. Blanketing involves excavating ballast and clay to a depth of 24in below sleeper level, and laying a bed of sand and stonedust which incorporates a polythene-sheet membrane to aid drainage. On this 9in-thick blanket the new ballast is laid in the normal way. This occurred on nine miles of the Badminton line, where, because of local soil conditions, the clay base had to be blanketed to produce a satisfactory road bed.

*Above:*
The high standard of Western Region track is illustrated in this photograph of a Paddington-Swansea express passing Undy Yard, Severn Tunnel Junction, in June 1983. *Michael J. Collins*

A feature of railway working in the early 1970s was the way in which major schemes were carried out with the minimum of interference to the services concerned — in marked contrast to the earlier London Midland main line electrification, for example. Thus, on the WR, all work was carried out within the normal pattern of possessions, apart from the Badminton line where, because of the severity of the work involved, it was decided to close the route from May to October 1975. During this time, the civil engineers were able to carry out work which would have taken three years of weekend possessions. In addition to the nine miles of blanketing, eight miles of track were lifted and 12½ miles reballasted. At the same time two overbridges were reconstructed to give increased headroom and tunnel refuges enlarged to allow for higher passing speeds.

When planning its track-improvement work for the HST, the WR was, to a certain extent, working in the dark, because it was not until 1975 that firm delivery dates for the first production HST sets were known, not that track improvement is something which can be accelerated greatly. Whilst mechanisation has meant that the work can be carried out faster, no way has yet been found of producing a year with more than 52 weekends. So the track-improvement programme was planned within the normal limitations of balanced possessions to keep the railway running while work was carried out. In the event, production HST delivery schedules and the civil engineering programme merged for October 1976.

The first section of up-graded line to be authorised for 125mph was between Mileposts 43 and 63 (Pangbourne-Challow) followed early in 1976 by MP12-32 (Hayes-Twyford) and MP87-94 (Wootton Bassett-Hullavington). By October 1976, the route was cleared for 125mph through to Westerleigh Junction and Bristol Parkway. The final section planned for 125mph — Wootton Bassett to the eastern end of Box Tunnel — was authorised in May 1978.

In addition to upgrading the infrastructure for 125mph there have been five major realignment schemes to eliminate 90mph speed restrictions.

**Twyford:** The original running lines were the straight pair of tracks now the relief lines. The present main lines were formed when the route was doubled and thus curved round an island platform. To ease these curves the island platform was narrowed and new up and down platform faces were built. A bridge at the London end of the platforms also had to be rebuilt because the existing arch would not give the clearance needed by the slewed track.

**Tilehurst:** This was a relatively simple operation because the curve is in open country. The track was slewed to flatten the curve and a bank had to be cut back slightly.

**Pangbourne:** A similar scheme to Twyford except that in this case the traffic department was able to do without the main line platforms. The work involved narrowing the island platform and flattening the curve.

**Chippenham:** The original layout had an ordinary platform, with the station buildings serving the down main line. An island bay platform served the Calne branch from one face and the up main line from the other. To flatten the curve, the down main line was transferred to a new platform face on the Calne branch

side of the island platform, which now serves both main lines. As a result, it was possible to remove some of the former down main line platform.

**Thingley Junction:** Here a curve, which could easily be canted for 125mph, had the branch to Westbury coming off its back. The solution adopted was to realign the whole section, creating two curves on either side of a straight section containing the junction. This involved slewing the track by 30ft.

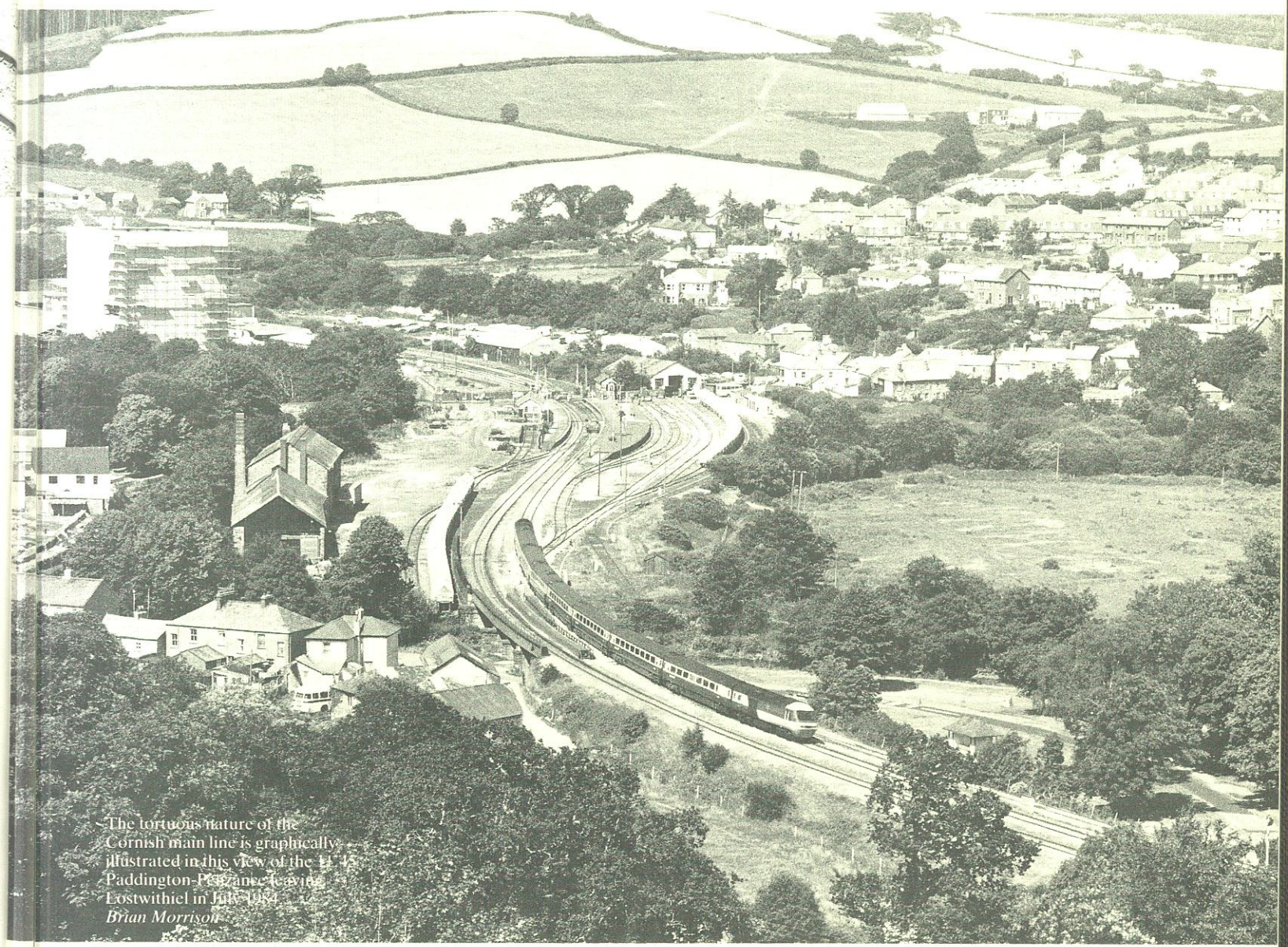
In the ten years since the Bristol/South Wales route was upgraded for the 125 era, subsequent improvements have been made. As can be seen from the line speed profile charts, 125mph is authorised from Acton Yard (MP4.5) and continues through to Reading station where the complicated pointwork imposes a restriction of 80mph. A speed of 125mph is then allowed as far as Swindon, where there is a restriction of 100mph. On the Bristol line, the 125mph limit ends at Box Tunnel after which speeds are lower through to Temple Meads. There is no 125mph track west of Bristol, but certain sections are approved for 100mph.

Trains bound for the South Wales line diverge at Wootton Bassett Junction where the speed is 125mph for the direct line to Chippenham, and 70mph towards South Wales. Speeds then vary between 110, 125 and 120mph as far as Bristol Parkway. Speeds west of Bristol Parkway are much lower. However, the WR has subsequently made a number of small upgradings — particularly between Cardiff and Swansea — but these are at lower levels.

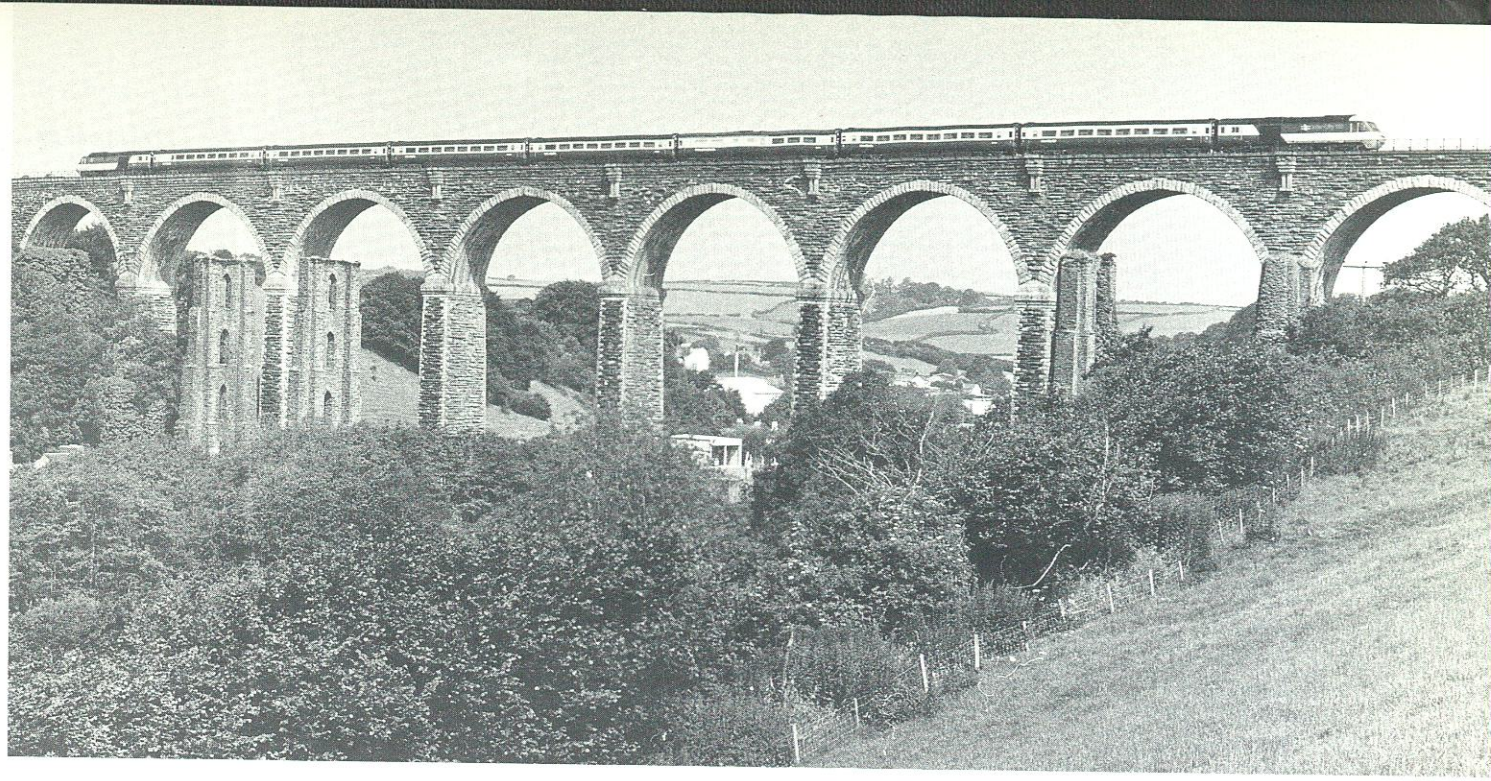
## West of England (Reading to Taunton)

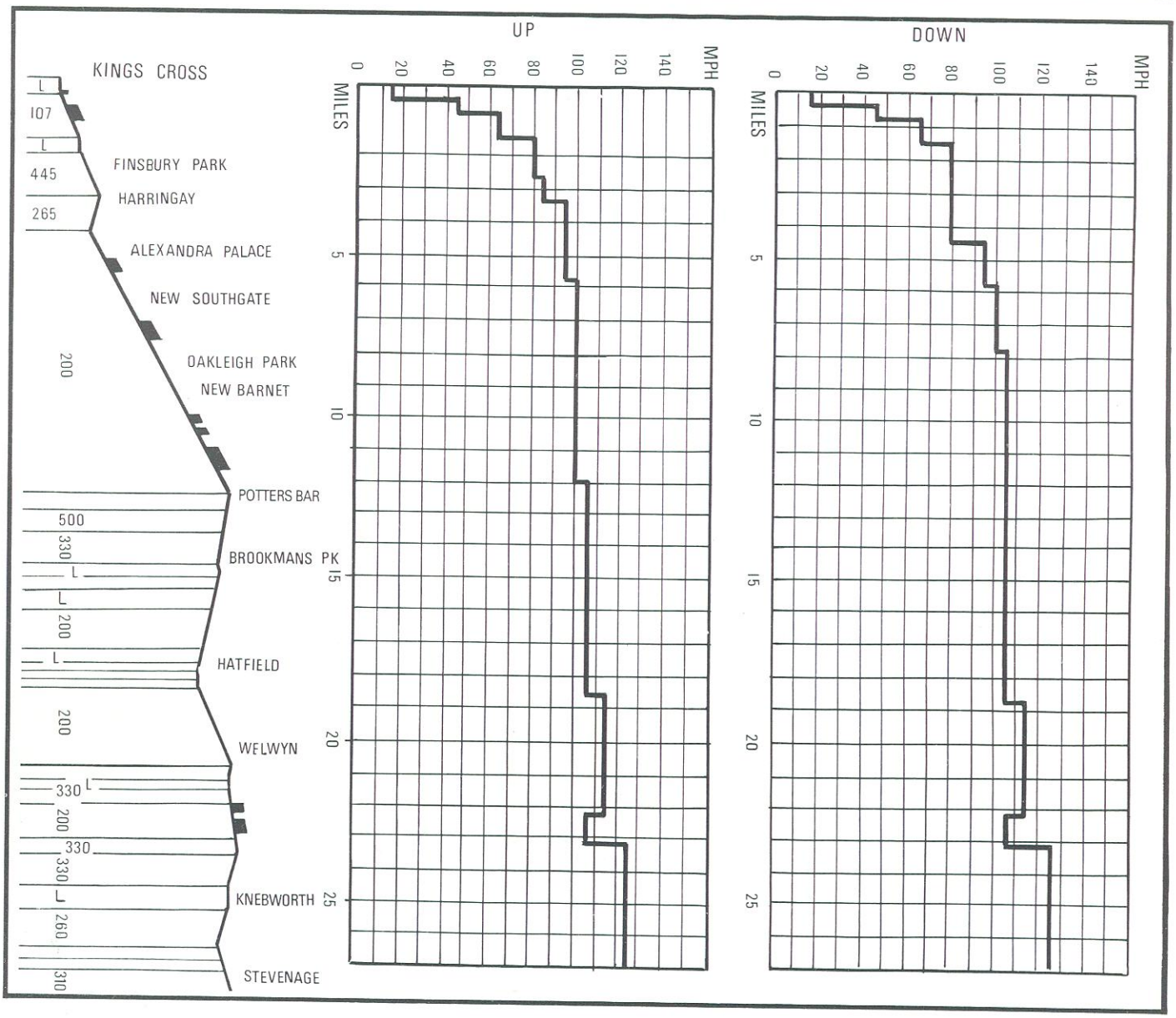
Because it was a trunk route created from a number of separately-conceived branch lines, the West of England route from Reading to Taunton, over the Berks & Hants line, was never a high speed route in the same league as the neighbouring line to Bristol, or the East Coast main line. In prewar days trains like the 'Cornish Riviera' and the 'Torbay Express' had a reputation for high speed, but competition was negligible and the only other effective means of public transport from London to the west was the long-distance coach which travelled over severely restricted trunk roads.

Because there was some doubt over the line's long-term role as a trunk route in the post-Beeching era, the WR concentrated its engineering effort on preparing the Bristol and South Wales lines for high speed running. Apart from routine renewals, the level of expenditure on the infrastructure of the Berks & Hants



The tortuous nature of the Cornish main line is graphically illustrated in this view of the 11.45 Paddington-Penzance leaving Lostwithiel in July 1984. *Brian Morrison*

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FINSBURY PARK
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HARRINGAY
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ALEXANDRA PALACE
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BROOKMANS PK
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HATFIELD
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*Below left:*
Line speeds and restrictions King's Cross-Stevenage.

*Left:*
HST speeds on the Western are often constrained by major engineering structures, particularly west of Plymouth. In this photograph the 09.00 Penzance-Paddington crosses Moorswater Viaduct in Cornwall on 8 July 1981. *Brian Morrison*

*Right:*
A location which has been remodelled to allow higher HST speeds is Aller Junction near Newton Abbot. An HST comes cautiously off the Plymouth main line, before remodelling was undertaken. *Mark S. Wilkins*

routes was therefore very restricted. Much of the existing alignment was unsuitable for speeds much above 90/100mph and the limited braking distances for the remaining manually-operated semaphore signals imposed a further restraint on high speed.

However, by the beginning of the 1970s, the WR had prepared a programme of route and signalling improvements which was put in hand in several stages. So far as the signalling was concerned, the work was essentially replacement of life-expired semaphore equipment with multiple aspect signalling. At the same time, the opportunity was taken to match the braking distances with the performance of the HSTs which were destined for the route.

In addition to blanketing the track and laying new continuous welded rail, there were two major civil engineering schemes. The first covered Midgham, Fairwood Junction and Curry Rivel and cost £430,000. At Midgham, a 40-chain slew and track recanting in the station, plus a slew over 30 chains to the west of the station, raised the line speed from 70 to 90mph. Track layout at Fairwood Junction was remodelled, with 57 chains of track slewed to a maximum of 15ft 9in, and a junction incorporating single leads was installed. Some bridge work was also necessary to accommodate the repositioned tracks, but the project raised the line speed for the junction with the Westbury avoiding line from 80 to 100mph. The maximum speed through Westbury station itself remained at 40mph. The reverse curves at Curry Rivel were eliminated by slewing a total of 68 chains of track. A 40-chain section was slewed 5ft plus a 2ft slew over 20 chains. Earthworks and minor bridge works were also required to raise the line speed from 80 to 100mph. When this work was completed, it was possible to raise the line speed over the Berks & Hants line to levels of 90/110mph.

As can be seen from the profiles, trains coming on to the Berks & Hants line at Reading have to slow from 125mph to pass through the sequences of 80, 40, 50 and 60mph restrictions as far as Southcote Junction, from where 100mph can be resumed. With the exception of various restrictions at Hungerford, Grafton and over the Westbury and Frome avoiding lines, speeds of 90/100/110mph apply through to Taunton. Taunton to Exeter has been improved, but the curvature is such that the maximum permitted speed in this region is 90mph. West of Exeter, of course, no high-speed running is possible because of the gradients and curvature of the route.

## East Coast main line

Being the first BR region to acquire 100mph (diesel) locomotives, the Eastern Region was ahead of the other regions in preparing its track and signalling for high speed running. By the start of 1969, plans had been finalised for a number of projects designed to eliminate the many long-standing East Coast permanent speed restrictions. A two-stage programme of works was implemented between 1970 and 1973. This enabled the fleet of Class 55 'Deltic' locomotives to be used at their full 100mph potential for a significant part of the route. But, by this stage, the ER already had its sights on 125mph in anticipation of the High Speed Train programme. Within a few years, most of the route which had been upgraded to 100mph had become suitable for 125mph running. The route has also been comprehensively resignalled and this has contributed to speed increases at a number of locations. Highlights of the East Coast line speed improvement programme were:

| | |
|---|---|
| **Hatfield** | Curve eased out and line speed raised from 80 to 100mph; subsequently raised to 105mph for HST working. |
| **Offord** | Major realignment to eliminate curves imposing a restriction of 70mph; line speed raised to 100mph and subsequently to 110mph for HST working. |
| **Peterborough** | Major station and layout reconstruction. Speed for non-stopping trains on the new pair of through lines raised from 25 to 100mph; subsequently raised to 105mph for HST working. |
| **Grantham** | Major realignment to allow 90mph through station; subsequently raised to 100mph for HST working. |
| **Doncaster** | Line speed raised from 75/80 to 100mph following realignment and resignalling. |
| **Selby** | Small project to raise line speeds over the curves between north end of Selby Swing Bridge and Barlby Junction from 45/50 to 60/80mph. However, following the construction of the Selby Diversion, this section of the old main line has now been abandoned as a through route. |

**Durham** Realignment and resignalling; line speed raised from 55 to 75mph.

**Newton Hall** Railway moved to new alignment; line speed raised from 55 to 85mph.

The fastest section of the East Coast main line is between King's Cross and just south of Darlington station. Line speeds between Doncaster and Leeds are — and will probably remain — restricted because of track geometry and other conditions. There is also scope for limited 125mph running between Newcastle and Berwick on the Eastern Region; there are some short sections of 125mph route between Berwick and Edinburgh.

Speeds in the London area are restricted partly by signalling headways but also by aerodynamic factors in the numerous sets of tunnels. After passing Potters Bar, a speed of 105/115mph applies as far as Woolmer Green from where there is a continuous stretch of 125mph track as far as Offord curves and then on to Holme. Speeds between Holme and New England (just north of Peterborough station) are lower, but 125mph then applies for 22 miles on to Stoke Tunnel. For the next 10 miles between Stoke Tunnel and Barkston, speeds vary at 100/115mph, with 125mph then applying as far as Newark, where there is a 100mph restriction over the Midland flat crossing and the River Trent bridge. However, a project is now under study for the elimination of the Midland crossing. A new curve could be installed so that Provincial DMUs between Nottingham and Lincoln would use the East Coast Northgate station instead of the Castle station which would be closed. As the River Trent bridge is fit for 125mph, a continuous stretch of high speed route from Barkston to Doncaster would be achieved. Speeds beyond the River Trent bridge through to the outskirts of Doncaster are mostly at 125mph, with lower speeds at Egmanton (115mph), Retford (115mph) and Bawtry (110mph). The speed through the Doncaster station area is 100mph, but rises again to 125mph by Shaftholme Junction, from where it continues at a steady 125mph through to the approaches to York station. North of York there is an uninterrupted stretch of 40 miles of 125mph route as far as Croft Spa (110mph) with a further couple of miles at 125mph before Darlington station. Speeds over the next 36 miles, between Durham and Newcastle, vary to a considerable degree, but the highest is 110mph, permitted at only two locations.

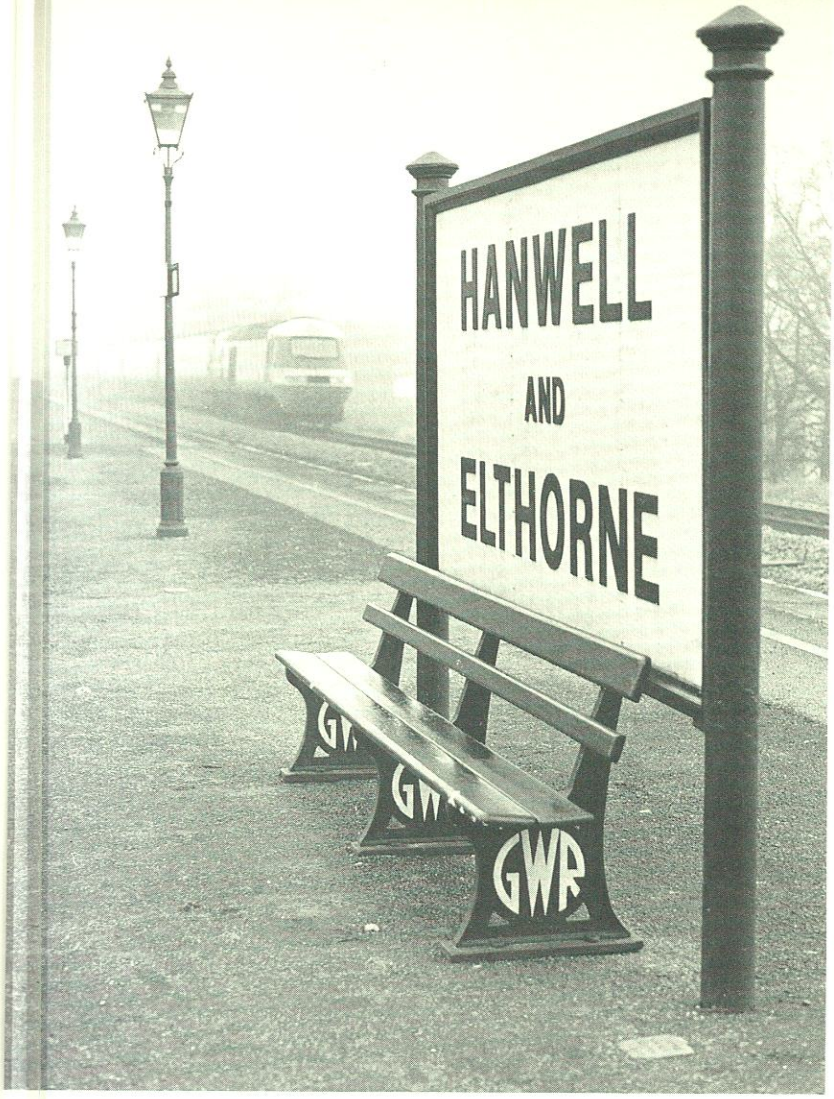
Unfortunately, there was little potential for upgrading the 125 miles of the East Coast main line between Newcastle and Edinburgh at an acceptable cost. Consequently, 100mph is the basic line speed between Newcastle and Berwick, with four short sections, totalling around 20 miles, passed for 125mph working. North of the Border the picture is very much the same, and there is only one short stretch of 125mph route, at Prestonpans.

*Below:*
Pioneer production set No 253.001 passes the new Westbury power signalbox in October 1986. *Michael J. Collins*

*Right:*
Bursting from thick fog in November 1982, this Swansea-bound HST passes a reminder of its heritage. *Michael J. Collins*

*Far right:*
Typical Western Region track between Reading and Didcot. Note the depth of the ballast. *Michael J. Collins*

*Below right:*
Framed in the windows of a signalbox, now demolished, the 06.08 Penzance-Paddington HST hustles past the Merehead branch used by Britain's heaviest trains from the Foster Yeoman quarry.
*Michael J. Collins*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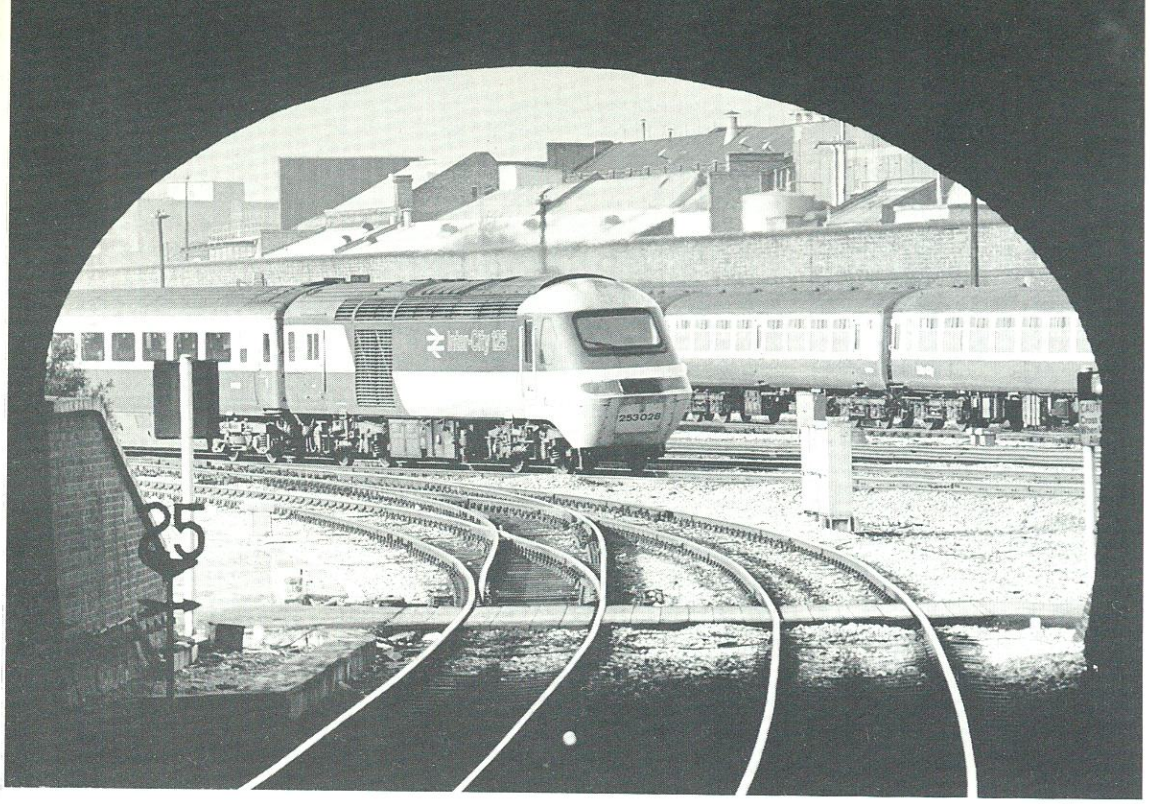
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*Top left:*
In November 1982, an HST passes Old Oak Common.
*Michael J. Collins*

*Above left:*
Another example of high quality WR permanent way as the 16.45 Paddington-Plymouth approaches Woodborough, between Hungerford and Westbury on the Berks & Hants line, in July 1984.
*Michael J. Collins*

*Left:*
Typical East Coast main line alignment at Abbots Ripton, north of Huntingdon. The train is the 11.35 Edinburgh-King's Cross, seen in July 1984. *Michael J. Collins*

*Above:*
One of the curves which the ECML improvement programme could not touch. This is the 16.00 King's Cross-Aberdeen negotiating Clifton curve, north of York, in August 1984. *Michael J. Collins*

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*Left:*
Selby's sharp curves and swing bridge imposed severe speed restrictions on all traffic. *Michael J. Collins*

*Below left:*
In contrast, the new Selby diversion, built to take the ECML around the new Selby coalfield, was aligned for high speed and saves time despite being longer. Here the southbound 'Aberdonian' gets into its stride having entered the diversion at Colton Junction in August 1986. *Michael J. Collins*

*Above:*
The 17.55 King's Cross-Bradford runs round Essendine curve in June 1984 — another example of the high-quality track formation on HST routes. *Michael J. Collins*

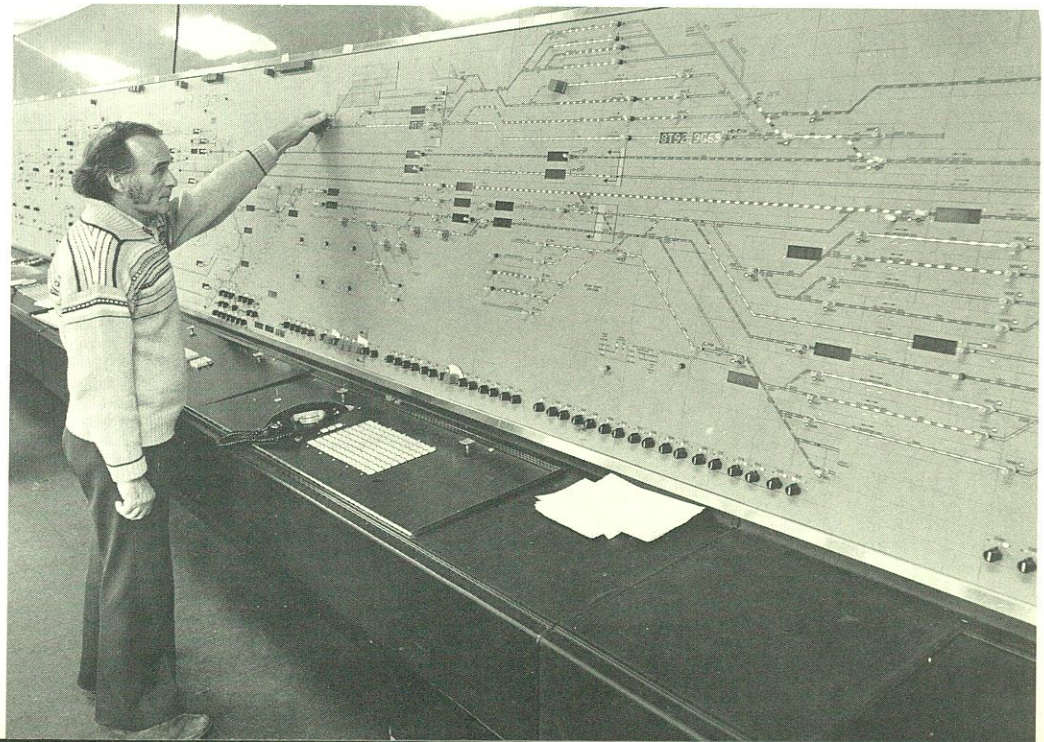
*Below:*
The collapse of the tunnel at Penmanshiel disrupted the planned introduction of HST services on the ECML. The new earthworks are clearly visible as the 16.35 Edinburgh-King's Cross passes Penmanshiel in August 1984. *Michael J. Collins*

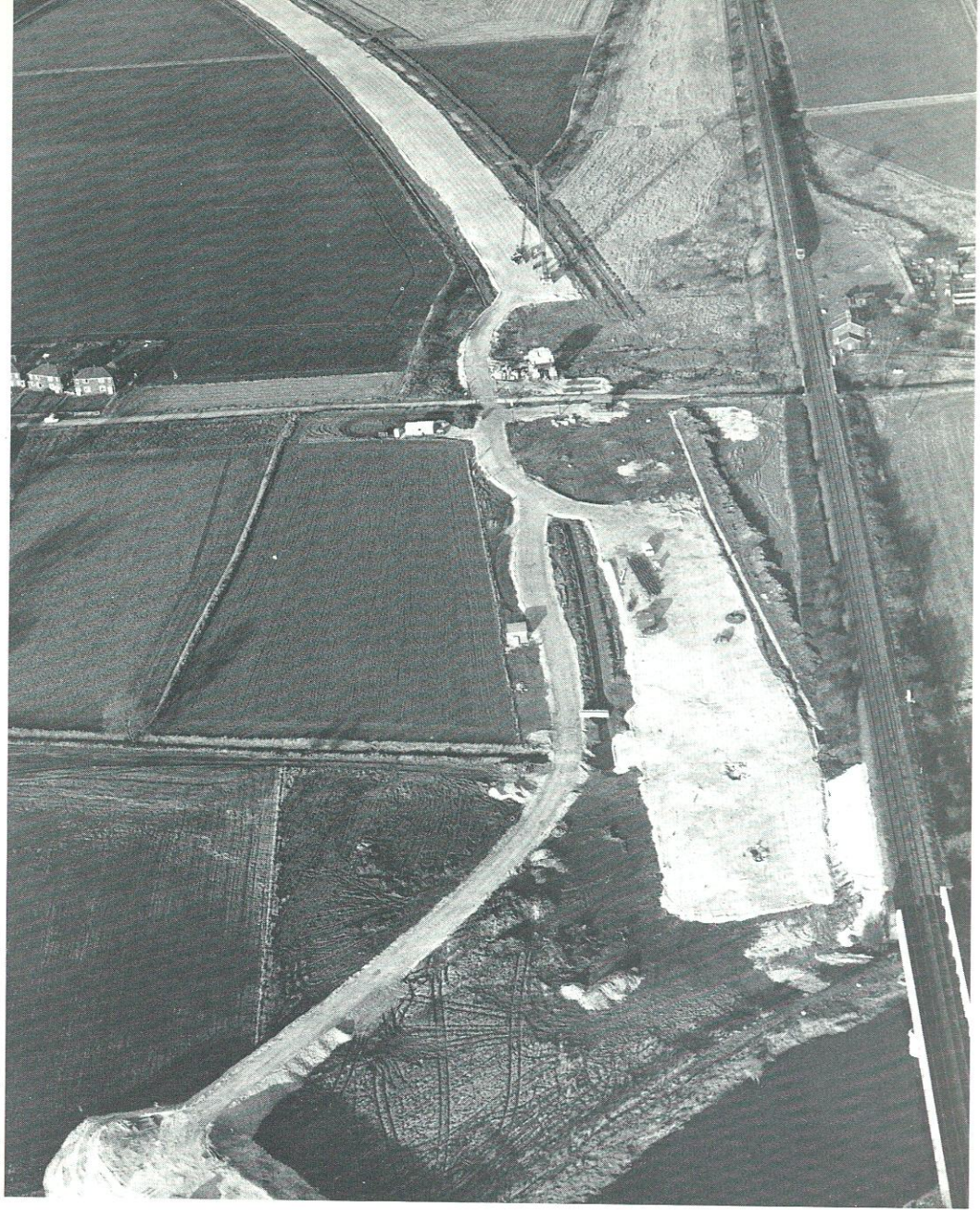
*Left:*
Illustrating the constraints imposed by alignment in the West Country is this view of the 08.30 Penzance-Paddington leaving Bodmin Road (now Bodmin Parkway) in April 1986. *Michael J. Collins*

*Right:*
A factor in the selection of Paddington-Bristol as the first HST route was the large number of level crossings on the ECML. This is Marholm Crossing, Helpston in April 1985. *Michael J. Collins*

*Below right:*
Peterborough station in 1972 looking north with the new island platform and track to the left. Note the extensive use of timber sleepers at this relatively late date. *BR*

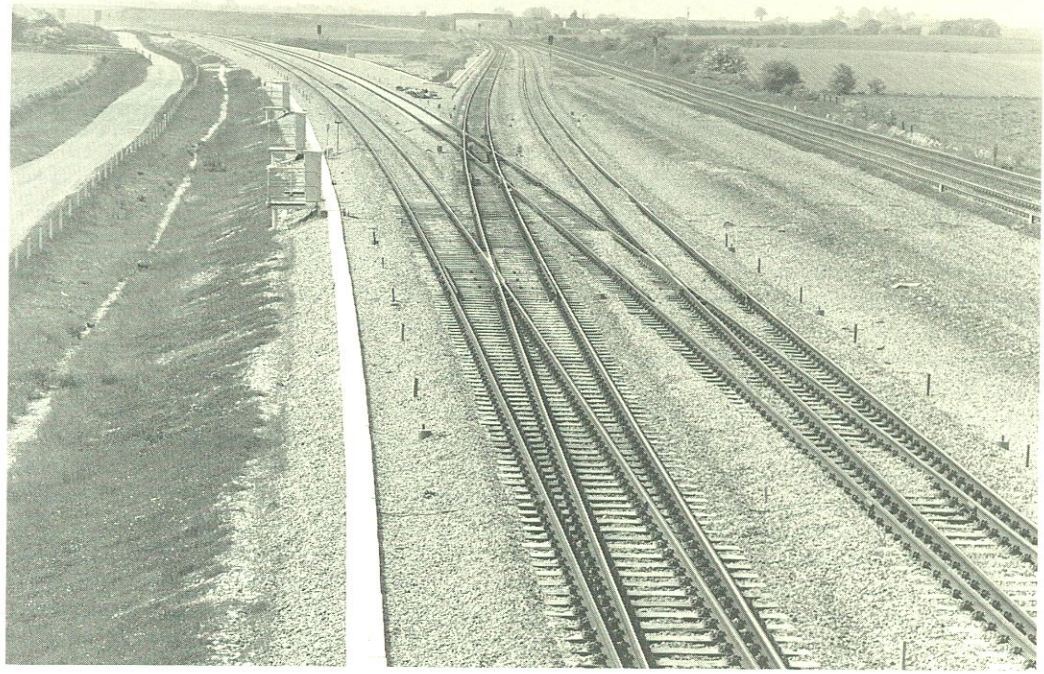
*Bottom right:*
A further improvement to East Coast main line services came in 1979, with the opening of the new Doncaster power signalbox. This is a section of the main panel. *BR*





*Right:*
In January 1981, the southern end of the new Selby Diversion is a white scar curving away northwestwards from the existing East Coast main line. *BR*

*Below:*
By December 1981 work is well advanced at the northern end of the diversion, with the track ballast and signalling relay rooms already in position as an HST from the West Country passes the site of Colton Junction. *BR*



*Above left:*
The completed Colton Junction is the first high speed junction on BR designed for 125mph running. In this photograph, looking south, the new diversion curves away to the left. *BR*

*Left:*
An unanticipated alteration to the East Coast main line followed the tragic collapse of Penmanshiel Tunnel. On 20 August 1979, the 10.15 London-Edinburgh 'Flying Scotsman' takes part in the official opening of the new Penmanshiel diversion. *G. A. Watt*

*Below:*
Preparation for HST included the creation of new depot facilities. In April 1981, Class 50 No 50021 takes two power cars from Laira maintenance depot to a stabling siding alongside the new HST depot then under construction. New trackwork in foreground leads into the new depot.
*Rex Kennedy*

CHAPTER THREE

# The Longest Day

With the 1985 timetable, HST utilisation reached a peak. It was a short-lived peak, because screwing the maximum use out of InterCity's limited High Speed Train assets was found to have adverse side effects on overall quality of service. In particular, while minimising turn-round times at terminals boosted the hours trains could spend on-the-move earning money, the resulting short time left for passengers to board after the cleaners had prepared a train for its next journey resulted in massive queues at stations like King's Cross. Thus, from the May 1987 timetable, turn-round times were extended, queues shortened and passengers had a more enjoyable journey.

But while it lasted, BR operated diagrams with diesel traction involving daily mileages matched, if at all, only by electric trains on high speed lines in other countries. Such intensity of operation depended on both human and technical excellence. The unsung heroes of this unique operation were the men and women who cleaned, maintained and repaired the trains in a nightly race against the clock. Their story is told in a later chapter. Complementing the human endeavour was the performance of the trains themselves. Good news does not sell papers and so failure takes priority over success. But, behind the well-publicised occasional problems, HST has progressively become a much better train in the years since its debut. In terms of availability, maintenance cost, mileage between overhauls, passenger capacity and reliability, the performance of today's HST exceeds the promises which justified its procurement.

All these factors contribute to HST's unique ability to earn money. In 1986, each HST on the East Coast main line earned, on average, £3.3 million a year. After taking away £495,000 for maintenance, and at a 1986 price of £3.5 million, a new HST would still pay for itself in just 15 months. That is the earning power that has kept InterCity in business. Its achievement has meant taking HST and its power equipment into entirely new territory for diesel traction.

Nothing demonstrated the demands made on HST better than Duty No BN051 on the East Coast main line between 1985 and 1987. While there were five daily diagrams exceeding 1,000 miles, BN051 was unique in several ways. First, it was the longest. And where the other high-mileage diagrams involved several journeys during the day, BN051 was a straightforward out and back working — from King's Cross to Aberdeen; with running to and from Bounds Green depot, a total of 1,058 miles. On top of that, it was a self-contained diagram and one where reliability was critical. A 'good' set could find itself making the longest journey for several days in succession.

For the HST allocated to BN051 the working day started at Bounds Green at around 06.00 as the driver who would ferry it to King's Cross arrived to prepare it for service. This is the train seen sitting at Bounds Green on 4 September 1986 as Driver Spouse climbs on board. At the London end is power car No 43158. Delivered to Neville Hill depot in April 1981 it has completed 1.2 million miles in the five years and four months since entering service. A more impressive statistic is the 325,000 miles the power car has covered since its last classified repair at British Rail Engineering Ltd, Derby. It will run another 125,000 miles before returning to the works again. The eight coaches of Set 39 have run 260,000 miles since their last classified repair at Derby. Externally, only the odd scrape on the paint and rusting spots on the freshly cleaned, gleaming paintwork hint at this hard-working existence. Inside, the refurbished interiors belie the age of the train. When asked why he had not celebrated the 10th anniversary of InterCity 125 services in 1986, InterCity Sector Director Dr John Prideaux replied, 'We don't want people to realise it's an old train'. Set 39, turned out to Bounds Green's customary high standard, emphasises this point. In the new colours and fabrics, InterCity 125 is very much a train of the 1980s rather than the 1970s. Completing the train is a real East Coast veteran. Delivered to Heaton depot in October 1977, No 43062 is one of the original batch of power cars supplied for the start of the East Coast InterCity 125 services. It has now completed 1.7 million miles — and hard miles at that. In contrast, HSTs predecessors on the East Coast route had a relatively easy life. It took the first Class 55 'Deltic' 12 years to reach the two million mile mark. As an indication of the HST work rate, No 43062 has completed 190,000 miles since it was last shopped in November 1985.

Duty No BN051, the 'eight o'clock' in Bounds Green parlance, is the last HST off shed, and as Driver Spouse starts the engines, their exhaust note breaks the silence of a deserted workplace waiting for the day shift. This morning, the brake test takes longer than usual. As the brake controller in No 43158 is advanced, the dials indicating the brake pressure on each power car bogie start to read only when the handle reaches Step 3. The remedy is to work the brakes with a series of applications and releases, which does the trick. There is no such problem in the other power car. Next, Driver Spouse checks the operation of the driver safety device (DSD), thumps the emergency button which, if the electrically-operated brake controller malfunctioned, would give a direct brake application by opening the air-pipe to atmosphere and, finally, checks the brake gauges as the guard in the rear cab makes the brake continuity test.

It is just after 06.30 and the 'eight o'clock' is ready to leave. From inside the depot, the driver cannot see the starting signal, so a shunter outside the shed waves the train on. Only a touch of controller is needed to get the set moving, and at 06.43 it emerges into the early morning sunlight. As the driver advances the controller to Notch 5 at 30mph, the wheels slip on the dew-covered rails, and the engine revolutions fall and rise again as the wheelslip protection system goes through its cycle.

For much of the run down to King's Cross, the controller rarely goes above Notch 2. Two sleepers pass on the main line while the driver wonders which platform will be allocated for his train. It should be No 4 and, as the signal clears just outside Gasworks Tunnel, the display shows '4'. At 07.03, 10 minutes before its booked time, Set 39 berths at Platform 4 and the engines are stopped. Now it takes on two new identities, public and working. The station public address announces that the train now standing at Platform 4 is the 08.00 to Aberdeen, the 'Aberdonian'. On the panels of the King's Cross signalling centre it is shown as 1S16.

Throughout the train, final preparations are made. The restaurant car has been set for breakfast at the depot, and Chef Cassar starts work while the Chief Steward and his team get ready. Parcels are loaded into the luggage compartment of the platform end power car as Guard Carnegie goes through his paperwork. And the aristocrats of the railway service arrive, Drivers Tomkinson and Brown, two top-link men from King's Cross who will take 1S16 as far as Newcastle.

The first thing they do is go through the preparation procedure all over again and they are very thorough, as one would expect from men at the pinnacle of their profession. Having been through both power cars, they climb into the leading cab and, in accordance with the roster, Driver Tomkinson takes the controls for the first leg. Having adjusted the seat to his liking, he gets out an elastic band and stretches it between the reverser key and the knob of the advanced warning system (AWS). Without this modification, the key rattles and, says Driver Tomkinson, 'gets on your nerves'.

Next, he winds up the clock in the desk panel and then carries out a brake continuity check. The Inspector accompanying this trip, because a passenger is in the cab, remarks that the brakes were checked at Bounds Green. 'I don't give a damn what happened at Bounds Green', replies Driver Tomkinson. 'This power car came out with the low water relay trip cut out, and what about the (diesel engine) sump at the other end? The engine oil's right on the minimum level.'

At 08.01 the train pulls out. Accelerating hard in Notch 5, the wheels slip momentarily leaving Gasworks Tunnel and once again power is reduced and then reapplied automatically. Driver Brown is reading No 43062's repair book in which train crew report details of problems requiring attention. As the train surges through Finsbury Park at 75mph he tells Driver Tomkinson that it says, 'Low on power this end; no fault found'. His colleague considers this as the lineside speed restriction signs climb from 80 to 95 and then to 105 just before Oakleigh Park. This sign is passed with the speedometer needle spot on 105mph. After 11 minutes at the controls, Driver Tomkinson gives his opinion — 'This is a good one. With some you're so low on power you're still on Notch 5 through Hatfield.' This is a reflection of the emergency measures taken during the spate of exhaust manifold failures during the summer that has just passed. Until it was found that a new antifreeze formula was attacking the Valenta's cast alloy manifolds, some engines were 'slugged back' (de-rated) to 2,000hp.

First stop is Stevenage, 27½ miles covered in 20min, start to stop, an average of 82.5mph. There have already been nine changes of controller setting in this short sprint. In every case, whenever full power (Notch 5) has been selected, it has been followed by Notch 1 (idling). As a later chapter describes, this frequently-repeated cycling from full power to idling has been at the heart of the problems encountered with the HST engines. To keep to schedule drivers have to use the controller like an on/off switch. Just keeping to time for the first 20min has meant that the train has either been running at line speed or accelerating hard in Notch 5.

Now this thermal cycling starts again as Driver Brown pulls the controller back to Notch 5 with an encouraging, 'come on darling'. A log was taken of the power controller settings for this run, and there were six changes of power setting between 08.28 and 08.34. Not until the climb to Stoke Summit will the engine have the chance to stabilise at its designed full-load temperature. Between Mileposts 50 and 51, a stop-watch check gives a true speed of 124.5mph at an indicated 125mph on the speedometer.

A dead stand outside Peterborough means that time regained by the driver's skill in passing every marker exactly on the line speed is lost again and the 'Aberdonian' is still 1min late. A full platform ensures that the station stop occupies all the time allowed, and more, and departure is 2min down on schedule.

Dominating every northward run on the East Coast main line is the ascent of Stoke Bank. While *Mallard* entered the record books on its 126mph run down the bank, climbing Stoke Bank provides the timeless measure of East Coast motive power machismo. In 1959, the prototype 'Deltic' heralded the diesel era on the East Coast route when, after covering the level two miles past Corby Glen at 92mph, it passed Stoke summit at 86.5mph with a trailing load of 360 tonnes. Today, the 'Aberdonian' has been racing past the signs that this era is coming to an end, as

*Right:*
Ready to go — the 'Aberdonian' at King's Cross on 4 September 1986, at the start of the run described in this chapter.
*Roger Ford*

trackside teams erect the overhead line electrification equipment which will provide power for the new generation of East Coast electrics in the next decade.

On high speed trials, shortened HST formations have gone up Stoke Bank faster than *Mallard* descended. But the 'Aberdonian' is a standard eight-car formation and it does not have the favoured treatment from the operators to ensure a fast ascent. While some of the quick runs by 'Deltic' plus eight formations saw Stoke Bank breasted at just under 100mph, these climbs were preceded by storming runs at line speed, or better, through the level approaches. On 4 September 1986, there is a temporary speed restriction (TSR) at Helpston which brings the 'Aberdonian' down to 20mph — 10mph faster than other traffic because of the lower track forces. Thus, at 09.01, when the tail of the train clears the TSR and Driver Tomkinson selects Notch 5, there are 18 miles of almost continuous climbing ahead from virtually a standing start. It is all in a day's work for the two power cars. At last, the engines are on sustained full throttle, ideal operating conditions, and the speedometer needle moves relentlessly round the big dial. Over the final three miles at 1:178, the power from the Valentas and the effects of drag and gravity balance at 112mph, so that the driver has to brake for the 105mph speed restriction at the summit, having covered the first 100 miles of the journey at an average speed of 83.3mph — including two station stops.

Next stop is York, reached, thanks to some determined driving and a clear run through Doncaster, 3min ahead of schedule. For the guard, each station stop means supervising the loading and unloading of Red Star parcels, a routine departure announcement over the public address, welcoming passengers on board, and then a ticket inspection through the train. Today, Guard Carnegie is joined by Travelling Ticket Inspector Artley of Newcastle.

There is a rhythm and routine to ticket inspection. Both men start off together side by side — Carnegie to the left, Artley to the right. The 08.00 is a popular train with tourists and non-business travellers, including large numbers of railcard holders. This means that the guard not only has to check the ticket, but has also to make sure that any discounted fare correlates with the holder's railcard.

Almost immediately, Inspector Artley spots a ticket code which shows that a Dundee-London saver was bought with a railcard. The passenger is not a railcard holder and claims that the ticket was sold in return for a request for the lowest saver fare to London. As the traveller declines to pay the difference between the normal saver (£47) and the discounted fare (£31) his name and address is taken so that a ticket irregularity report can be submitted to management.

As the men proceed down the train there is a pause at each vestibule while vacant toilets are checked and any open droplight windows closed. On popular tourist trains there are frequent queries for information. 'Where are we?', one passenger asks, and Guard Carnegie, who must have travelled the line hundreds of times, has to break off from checking and clipping tickets to look out of the window and gain his bearings. Afterwards he explains that passengers expect you to know where you are all the time, and they are surprised when you have to stop and check, but in a train like this the only way to find out is to look out of the window.

Ticket inspection completed, Guard Carnegie walks back through the train to his compartment in the leading coach. Using a hand-held 'clicker' he counts the number of passengers in each class. The increase in passengers after York emphasises the popularity of the 'Aberdonian' with tourists making a night

*Below:*
Racing ground — two HSTs pass with a closing speed of 250mph on the East Coast main line north of York. Trains are the 09.30 King's Cross-Newcastle, on the left, and the late-running 08.30 Glasgow Queen Street-King's Cross. *Michael J. Collins*

stop-over en route to Scotland. But despite the large number of red, white and blue BritRail passes, train loadings are down, due in no small part to the reluctance of American tourists to visit Europe in the aftermath of Chernobyl and their country's raid on Libya by bombers from British bases.

This is felt particularly by Chief Steward Rawley, Chef Cassar and the three stewards in the trailer restaurant unclassified buffet (TRUB). Last year, the train was 'full with Yanks'; this summer business has been flat. The 'Great British Breakfast', as ever, is the key economic marker. This morning the crew served 20 breakfasts compared with 40-50 a year ago. Similarly, the buffet bar has not been busy throughout the journey — 'steady, but not overworked' is how the crew describe it. On their return working of the 16.35 'Talisman' from Edinburgh this evenings takings should be double those of the morning run.

Lunch has been prepared for 17 settings, including two roasted joints of beef complete with a pile of Yorkshire puddings. One of the stewards announces the only sitting for lunch and just one passenger responds. She orders a steak, so the two joints go into the refrigerator and will accompany the crew on to the return working. This highlights the one remaining problem of meeting 1980s' travel needs with a 1970s' train — eating habits have changed considerably. The conversion of InterCity 125 catering cars to 'Cuisine 2000', which enables supply to be tailored more closely to demand, is described in another chapter.

While the solitary lunch is being served, the Chief Steward is checking the cash taken and, just after the train passes Berwick, it is announced over the public address that the buffet will be closing in 10min time and will reopen immediately after leaving Edinburgh. With the buffet closed, the crew can check the stock they will be handing over at Edinburgh. For the hand-over, the departing crew fills in a form listing everything left on board. This means counting not only the number of cans of beer or bottles of wine, but also the exact number of rashers of bacon or slices of processed cheese. The next crew will check the form against the stores they find on board and will circle any discrepancy. This in the trade is called 'ringing'. While 'ringing' will continue with the new catering policies, sandwiches and other food prepared at shore bases has eliminated the health hazard of the well-thumbed rasher.

Approaching Edinburgh, the train still has another 2½ hours to run to the end of the journey. On a long trip like this, many passengers join at intermediate stations which means that their first impression is not of a freshly-prepared train, but one which has already been well-used by other travellers. The two worst problems are litter and toilets running out of water. At Newcastle a railman boards the train and collects rubbish from all the coaches. By stacking plastic trays, beakers and cups, a train-load of litter has been packed into two black plastic bags which will be unloaded at Edinburgh. A check of every toilet shows that they all have towels, soap and toilet paper. Only one, in Coach A, has run out of water but another, in Coach E, is running low.

Edinburgh is reached at 12.42, 8min up on the public timetable. It marks the end of the true InterCity section of the journey. The train will continue to Aberdeen because, in the past, the innovative ScotRail management spotted the opportunity to improve its 'domestic' services by using marginal time in a HST diagram. Having got HSTs North of the Border, ScotRail then looked at ways of getting the most out of trains' performance potential.

Clearly, Scotland is short of 125mph racing grounds. However, a common error is to think of HST as just a 125mph train. It is, in fact, simply a modern passenger train which can run at 125mph. As explained in an earlier chapter, this 125mph capability depends on a high power output, low track forces and a higher braking rate than conventional rolling stock. While unable to exploit the speed potential to the full, ScotRail was able to make use of the other features. A good parallel is a high power sports car which is faster from A to B on winding roads by virtue of better acceleration, braking and roadholding, even though it may not get anywhere near its absolute top speed. In railway terms, HST's all-round performance meant that ScotRail could reduce journey times by accelerating faster to a high speed while still being able to stop within existing signalling distances.

In the past, running one type of train faster than the rest might have been an insurmountable obstacle. ScotRail leaped over the problem in a single bound by introducing differential speed restrictions. These lineside boards bear the letters 'HST' plus the appropriate speed. As the train heads northwards from Edinburgh it passes a good example of the system. At Dalmeny, ScotRail has extended the concept to cover different types of conventional trains. Before the series of curves there are three speed restriction boards — 30, 40 and HST50. The middle board is for normal traffic and the lower speed is for heavy freight vehicles, such as grain hoppers.

But despite differential speed restrictions, HST is being used as a high grade diesel multiple unit by ScotRail. In the 130 miles between Edinburgh and Aberdeen it will make six stops, compared with four in the first 393 miles. On the return journey, the number of stops in the Scottish section will increase to eight. There may be no connection with the change from InterCity express to stopping train, but at 13.14, when Driver Rannie reapplies power, north of Inverkeithing, the engine in the leading power car suddenly runs back to idling and the ammeter reading falls to zero. After a pause the engine runs-up again and power is restored. Traction Inspector McArtney, who is in the cab, suspects a faulty governor and starts reading back-entries in the repair book.

The electronics and electric power equipment of HST is particularly reliable and it seems likely that the fault represents a temporary malfunction in the control link between the diesel engine and the electrical transmission. But at 13.26 the same power off/power restored cycle is repeated, and again at 13.31 as the train pulls away from Kirkcaldy. Here the line speed increases, first to 75mph, then, under a differential restriction, to 85mph and, despite a further loss of power, 90mph is reached before slowing to 75mph as Cupar approaches.

Clearly, there is an intermittent fault in the governor or control system and study of the repair book shows that it is not a new phenomenon. This 'loss of amps' was first reported on 21 July 1986 and since then other drivers have reported the same problem 18 times. At the depot, fitters have tested the control system, changed electronics control modules, or reported no fault found. On 23 August, one driver, noting that this is a recurring problem, has written, 'Power reduced as in all reports. Too many dummy fitters'. On the section of the page where the depot records remedial action taken, a fitter has written, 'All equipment checked OK. Tested under load in shed and not by dummies either'.

Power car No 43062 has one of those faults which can drive engineers to distraction. Something, somewhere, in the control system starts playing up only after the power car has been running for a prolonged period. Thus, tests in the depot, even with the power car on the static testing load bank, are unlikely to show up the problem as, even assuming the time could be spared, it is very difficult to simulate accurately the conditions experienced by the complete power system on a five-hour run

down the East Coast main line. The only solution is to either instrument the power car and record just what happens to various key parameters when the system misbehaves, and from there trace the problem, or to put a fitter on board in the hope that he will be able to troubleshoot while the symptoms are present, and diagnose the root cause.

Meanwhile, the effect on timekeeping of this intermittent loss of power is demonstrating clearly that ScotRail has applied some very tight scheduling to this apparently relaxed stopping service. At Dundee, Inspector McArtney takes the controls, and north of Broughty Ferry has the train running at 100mph on the fastest section of track on the Edinburgh-Aberdeen route. At Carnoustie the line speed drops to 90mph for a curve and then returns to 100mph. Despite this spirited running a further 2min has been dropped on arrival at Arbroath. When the loss of power occurs, the effect is severe. A typical example has the ammeter reading 400amp at 60mph when, under normal full power conditions, the figure should be 1,000-1,200amp. With the Inspector at the controls, the driver has gone back into the engine compartment and has checked the most likely source of power loss — lack of oil in the governor; it has been topped up recently. Inspector McArtney, like Driver Tomkinson earlier in the day, tries exhortation. 'Come on old girl', he mutters and, as if in response, the sagging ammeter needle slowly lifts.

In the end, Aberdeen is reached at 15.24, just 4min down after 524 miles. Now, after a very short turn-round, Set 39 and the two power cars have to retrace the route, down on power and with connections, often to the last train of the day, to be made all the way to London. By putting cleaning crews on board at Montrose, the turn-round time has effectively been lengthened by getting the tables cleared and heavy litter removed before the station team comes on board. One vehicle is vacuumed, while all the toilets are cleaned and soap, toilet paper, towel machines and paper towels are replenished. Permanent trackside hoses are used to refill the carriage water tanks while another railman puts reservation tickets on seats and then replaces the coach-side destination labels on the vestibule windows.

At the luggage van, the inbound parcels are unloaded rapidly and the Post Office crew drive up alongside with the southbound mail for loading. There are also Red Star parcels on board, some for the intermediate stops down the line to Edinburgh. In the buffet car, the steward has monitored the supplies remaining on board and, during the turn-round, telephones the Catering Department at Edinburgh to arrange for fresh stock to be alongside so that the buffet can be replenished for the long run home. This is the last London train out, apart from the sleepers, and it is loading well. Together with the extra urgency generated by the abbreviated turn-round, the result is a rare sense of occasion. This is reinforced at 16.00, when, as Guard Fraser steps on board and the train begins to move, a passenger comes sprinting through the barrier. If he misses the train he will not get home until tomorrow. There are no angry shouts from the barrier and the guard helps the passenger into the train. 'Take your time and get your breath back, Sir', says Guard Fraser to the panting, but relieved, passenger. Then the guard is off on the first of a series of sprints down the train. He has to check tickets after each stop and, as the timetable shows, there are rarely more than 20min between stops all the way to Edinburgh. Before each stop the guard has to return to his compartment in the rear coach to make the passenger address announcements and supervise the loading and unloading of Red Star parcels. Thus, on the first leg, there is time only to check the second class accommodation before returning to the compartment ready for the stop at Stonehaven.

Other guard's duties eat into the time available. One passenger for Hull wants to know about connections. After the next stop Guard Fraser gets to work with the timetable, and on the subsequent pass down the train is able to tell the passenger for Hull that he has a fairly safe connection plus a back-up in case the train is severely delayed. This is starting to look like a strong possibility. The temperature in the train feels higher than normal and Inspector McArtney has the explanation when he comes through the guard's compartment on his way to the rear power car. The electric train heating (ETH) power supply, which in modern vehicles also powers the air conditioning equipment, has been lost. While restoring the auxiliary power he also arranges it so that this power is drawn only from the rear power car, making all the output from the healthy front unit available for traction.

There is more cause for concern at Arbroath where the rear engine shuts itself down during a prolonged stop to take on a heavy load of Red Star parcels. The driver fires up the engine again successfully, but the rear power car is still showing the intermittent loss of amps, and on this all-stations run the effect on acceleration after each stop means that delay is accumulating relentlessly.

The stopping-train nature of the service means that business in the buffet is light. Relief Steward Lawrie has served but four passengers since leaving Aberdeen. After Dundee he announces the imminent closure of the buffet over the PA and suddenly there is a small queue for toasted sandwiches — with grilled rather than microwaved bacon — the most popular item. Then, at Kirkcaldy, the buffet shutters come down and the steward takes count of the stock on board yet again, cashes up, and prepares to hand-over at Edinburgh to the new crew who will be in charge of the buffet for the remainder of the journey to London.

Arrival at Edinburgh is at 18.37, 12min down, but some efficient station working has the train away 8min late, at 18.43, with Driver Glass at the controls and Driver Yates in the second seat. In the buffet, the cheese slices and bacon rashers are counted for the fifth time today by Chief Steward Branch and his assistant who prefers to be known only as Bill. They came to Edinburgh on the 11.00 from London. As the train pulls out, a passenger who is a diabetic comes to the buffet door and hands over his supply of insulin which the Chief Steward puts in the refrigerator. A queue starts building up at the buffet counter, and soon sliced loaves are being toasted on one side and rashers of bacon are grilled to speed the production of toasted sandwiches which the crew anticipate will be the most popular food on demand. They are less certain about the quantity of sandwiches which were loaded on when the buffet was restocked at Edinburgh; the previous steward has been over-optimistic they feel. As the shutters come down, Bill announces that the buffet is open and reminds passengers that there are no restaurant car facilities on the train.

Berwick is reached 12min down and Driver Glass is concerned about the report of the engine shut-down at Montrose. The rear power car is still losing power intermittently, but No 43158, even with the sump at the minimum oil level spotted by Driver Brown this morning, is as healthy as ever. With a balancing speed on the level of around 110mph with one power car, sheer speed is not going to be a major problem provided No 43062 generates at least some power most of the time. What will really suffer will be acceleration — the ability to get away smartly from a station stop or regain time after a temporary speed restriction or signal check. And, looking ahead, time is critical, particularly for those travelling through to London. The train is due in at 23.38 when

the Underground and suburban rail services will still be running. Arrival after midnight could leave passengers marooned at King's Cross until the next morning.

Now, it is all down to the skill of the drivers; and Driver Glass sets the tone for the night's work. Straight-backed and still, he sits at the controls concentrating totally on the line ahead. Alone among the drivers who have handled Set 39 today he has not fitted an elastic band silencer to the reverser key and, just as Driver Tomkinson said it would, the key tinkles away continuously. Not that it could break Driver Glass' fierce concentration as, back on the type of track it was built for, the train flies south, spearing down the perspective of the recently erected electrification support masts at the trackside.

Past Holy Island the speedometer indicates 110mph where a train with full power available would normally be doing at least 115mph. And yet, second-by-second, Driver Glass is clawing back lost time. Passing Morpeth, the deficit is back to 9min. With power and speed restricted, the only way time can be saved is by running as fast as possible for as long as possible before braking at the last moment so that the train passes the day-glo painted speed restriction marker at exactly the indicated speed. To do this with the precision which Driver Glass is achieving tonight requires knowledge of the track and familiarity of the train's braking characteristics that only experience can give — plus that unbroken concentration.

Unbroken, that is, until a red signal persists at the approach to a level crossing and the brakes must come on, dissipating precious momentum. Only as the train is about to stop does the signal flicker through the colour light sequence to a steady green.

*Below:*
A King's Cross-Aberdeen HST running along the coast at Burnmouth in August 1984. *Michael J. Collins*

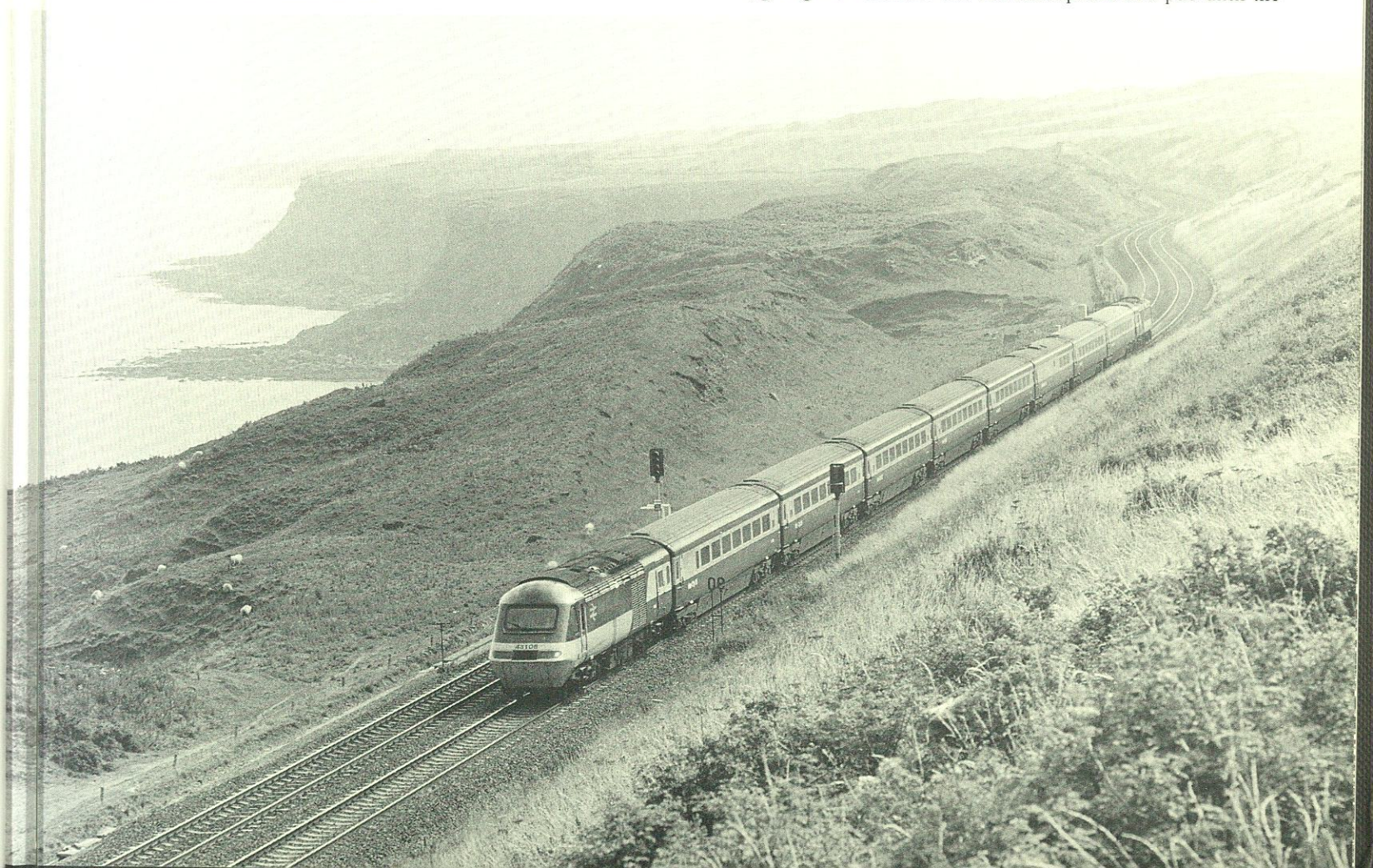
'That', says Driver Glass with feeling as he selects Notch 5, 'is how they ruin the HST service'. And then he starts clawing-back the seconds again, to such effect that, despite the stop, the train pulls into Newcastle only 8min down.

But from now on, the drivers' task becomes progressively harder as the journey moves on to the classic East Coast racing ground where lack of sheer top speed should start to tell when extended over long sections. The new crew is Driver Vardy, who takes the controls, and Driver Dunning, both York men. By Durham, the deficit is back at 9min and the fastest running is yet to come. Given a section of down grade, the train can work up to an indicated 115mph and then sustain this speed on the level. But from 90mph, as aerodynamic drag really starts to build up, the acceleration is painfully slow.

At Darlington the train is 10min late, and the fast run from there to York cruelly exposes the lack of power so that the deficit has increased to 13min when two King's Cross men climb into the cab to take over for the run home. Even so, the drivers can be proud of their achievement. The traveller to Hull has made his connection and will get home in good time tonight.

In the train, after 13½ hours in service, it is noticeable how well the 'ambience' is standing up to the long day compared to the original orange first/blue second class colour schemes which by this time of night would start to get garish and drab respectively. In the buffet things are somewhat fraught. A blocked overflow tank has flooded the work surfaces and the floor, which is still being mopped up. Business has been brisker than normal with the extra sandwiches ordered by Steward Lawrie at Aberdeen having been mostly sold. On the other hand, toasted sandwiches have not come up to expectations.

A feature of the HST buffet is the long ash bar which curves round into the vestibule. This was designed to provide an area where customers could drink without obstructing buffet bar service. Tonight a number of travellers are using the buffet as a bar, giving the vestibule end the atmosphere of a pub until the



shutters go up and another round of stocktaking and cashing-up starts. Takings for the night are just under £200, which compares favourably with the £300 taken by Chief Steward Rawley and his crew in the morning.

Up-front, the professionals are continuing to compensate for imperfect machinery, with skill and experience. At Doncaster the train is 15min down, increasing to 16min at Newark. But at Peterborough, a minute has been regained. As the train pulls in at 22.58, the station PA is announcing that the 22.56 connection to March, Ely and Cambridge has been held. When the guard made his passenger count before Peterborough, there were still 79 passengers in second class and four in first.

Just south of St Neots the train covers its 1,000th mile since leaving King's Cross this morning. In the buffet, the crew change out of their uniforms, and at the back of the train the guard sorts out his forms. Passengers sit or doze, waiting for journey's end. Only in the cab is concentration maintained as the train knifes through the suburbs now retiring to bed. And, with the help of a fluent run into King's Cross, the end result is a 14min late arrival after travelling 1,048 miles in an elapsed time of 15hr 51min.

Still, the train's working day has not finished. Just before midnight, the ferry driver gets on board and, after some difficulty starting the engine in the indefatigable No 43158, sets off for Ferme Parke refuelling sidings, arriving at 00.15. Tanks refilled with just under 1,000 gallons of fuel — enough for 1,400 miles — the train leaves Ferme Park at 02.30 and runs to Bowes Park, from where it will reverse into Bounds Green depot, arriving at 03.17. It finally comes to rest in its home depot at 03.33, nearly 21 hours after it left on what is now yesterday. There are just 3½ hours left for routine attention and remedial work on the troublesome control system in No 43062 before Set 39 leaves Bounds Green to form the 08.00 to Aberdeen for another long day.

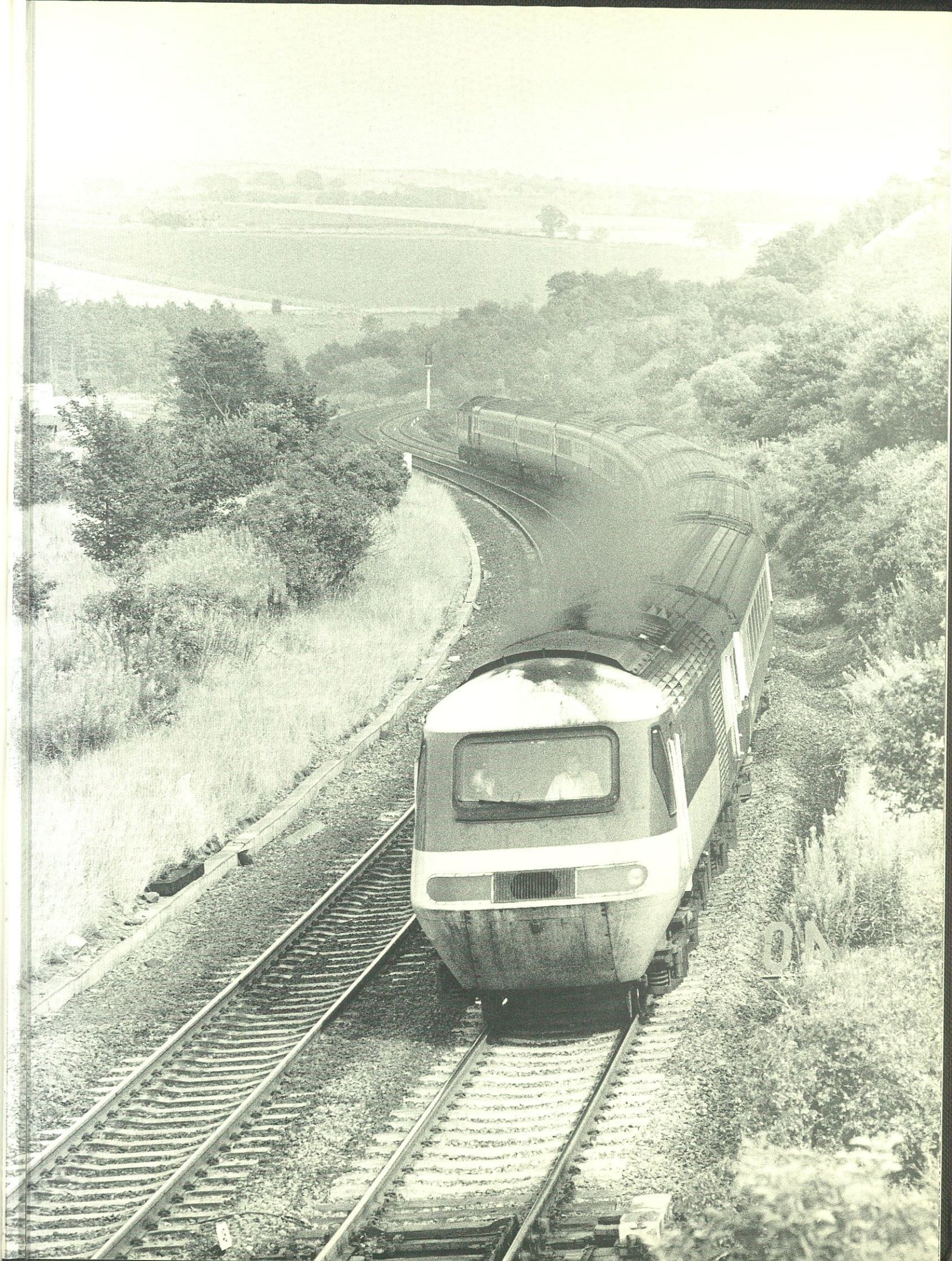
*Below left:*
Double act — guard and travelling ticket inspector work their way along the train. *Roger Ford*

*Below:*
'Ladies and gentlemen' . . . Making the public address announcement as the train approaches Newcastle. *Roger Ford*

*Bottom left:*
Tidy rubbish — hand-sorting has reduced the litter accumulated between London and Edinburgh to two plastic bags-full. *Roger Ford*

*Bottom:*
A Scottish Region differential speed restriction sign. *Roger Ford*

*Right:*
'Provincial' HST — a King's Cross-Perth train faces the combination of curves and gradient at Grantshouse in August 1984. *Michael J. Collins*



*Top:*
Advice for the passenger needing a connection at Hull. *Roger Ford*

*Above:*
Slack business in the buffet during the Scottish leg of the return journey. *Roger Ford*

*Right:*
An Aberdeen-London HST accelerates away from the Tay Bridge. *Michael J. Collins*

35

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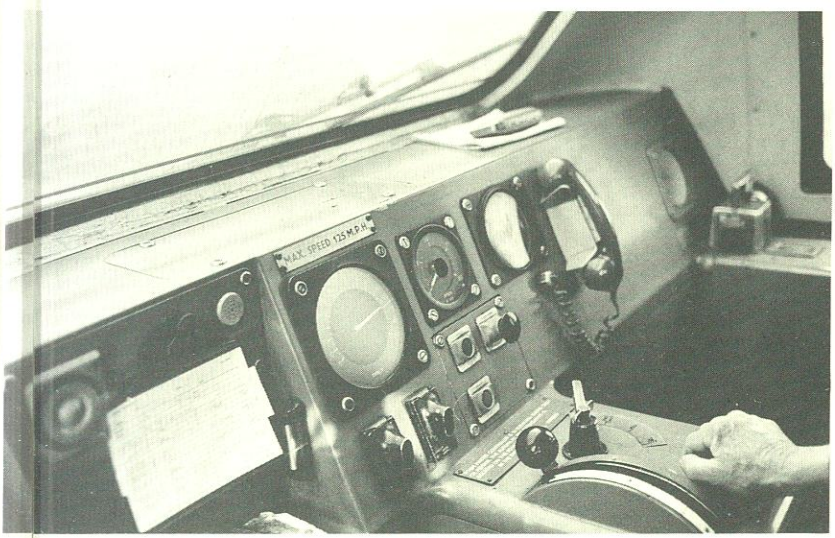



*Facing page, top:*
A thickening of the exhaust indicates that the driver is notching up after the speed restriction over the Forth Bridge, seen in the background. The train is the 13.05 Aberdeen-King's Cross, in August 1984. *Michael J. Collins*

Three views of the ECML show British Rail's 'Ligne à Grande Vitesse' at its best:

*Facing page, centre:*
At Overton, north of York, with the southbound 07.00 off Edinburgh in May 1982. *Colin J. Marsden*

*Facing page, bottom:*
At Abbots Ripton with the 10.00 Aberdeen-King's Cross, in July 1984. *Michael J. Collins*

*Top:*
At Thirsk, with the same train three days earlier. *Michael J. Collins*

*Centre left:*
Journey's end for hard-working power car No 43068 at King's Cross on 25 May 1986. *Brian Morrison*

*Left:*
Just 'another day in the office' for the driver of this HST which is coasting along at 124mph with the controller closed. *Brian Morrison*

CHAPTER FOUR

# Making The Case

Once HST was accepted, it became part of a long-term strategy designed to take InterCity from the mid-1970s to the early 1990s. This strategy had three key elements — a rolling programme of network electrification; development of an electric Advanced Passenger Train (APT) to achieve higher speeds on existing routes with expenditure on line speed improvements minimised; and construction of a fleet of High Speed Trains to upgrade services on routes either pending electrification or where electrification might not be justified. It envisaged a fleet of 130 APTs (80 for the West Coast and 50 for the East Coast main lines) and no less than 161 HST sets. Early Government agreement to electrify the East Coast main line was also assumed. It is now a matter of history that the Department of Transport was not prepared to endorse this optimistic prospectus. Even if the Department had not (with good reason) become sceptical of BR investment plans, following the experience of the 1955 Modernisation Plan, the early 1970s were the start of a decade of continuous economic and financial difficulty, aggravated by the 1974 oil crisis.

At this point it would be helpful to explain the relationship between BR and the Department of Transport (DTP) as far as capital investment is concerned. Unlike most private companies, where the Board of Directors will give approval to a series of projects or to an overall investment programme, BR has to obtain DTP authority for each financial case on a project-by-project basis. While this policy ensures that the Government gets good value from the money it provides to support BR, it does slow down BR's decision-making process, and can sometimes produce perverse decisions. Some BR Chairmen have tried to modify these rules, but so far without success.

The merits of a rolling programme of investment are easy to support. Long-term corporate planning is more efficient, projects can be integrated more effectively, and the cost of equipment is cheaper if ordered on a long, rather than a short, production run. At separate times, and for different reasons, past BR Chairmen, Sir Richard Marsh (later Lord) and Sir Peter Parker, both tried, unsuccessfully, to obtain Government approval to the 'rolling investment' concept. Ironically, Sir Richard Marsh was previously Minister of Transport in an earlier Labour Government.

Thus BR was faced with the prospect of arguing the case for each item in the original high speed prospectus on a project-by-project basis. APT and HST prototypes were ordered and built, but any hope of network electrification was roundly rejected. Over a decade was to pass before East Coast electrification was eventually authorised in July 1984, by which time the sad saga of the APT had run its unhappy course and the trains sent for scrap.

British Rail planned to build its fleet of 161 HSTs in six batches. The first was 27 trains for London (Paddington), Bristol and South Wales followed by 42 for the East Coast main line, 16 for London (Paddington) to the West of England, 10 for the Midland main line, 36 for the North East-South West (now known as Cross Country InterCity), and 30 for a variety of other secondary routes, including Edinburgh-Glasgow and Trans-Pennine. Construction would have been at the rate of 30 to 40 trains per year over a four to five year period. The 42 East Coast sets would have remained on the route for about six years before being replaced by APTs. In the event, only 95 trains were authorised and construction spread over a period of 10 and not six years. The first build, of 27 sets, was authorised in September 1972 and the final build of four extra East Coast trains in January 1980. HST construction terminated with a batch of 18 trailer vehicles, completed in 1982, so that a number of trains in the fleet could be strengthened from seven to eight trailer vehicles.

The most interesting feature of HST deployment is how and why today's utilisation of the 95-train fleet differs, not only from the original proposals, but, if necessary, is changed on a year-to-year basis. Department of Transport authority for HST construction was given in response to five separate financial cases — referred to as submissions — tabled by the British Railways Board. These were: London (Paddington)-Bristol/South Wales; East Coast main line; London (Paddington)-West of England; Cross Country (North East-South West) and four extra sets for the East Coast main line.

## London-Bristol/South Wales

Deliveries of the Western Region's fleet — each set formed with two power cars plus seven trailers (2+7) — began in early 1976. It was intended to introduce the service in two stages — October 1976 and May 1977, but a combination of production difficulties and Government investment cutbacks delayed the implementation of the full service until October 1977. As the first region to operate HSTs, the Western had to climb the 'HST learning curve' and iron-out technical and operating problems while the trains were in service as described in *Chapter 5*. Accordingly the first timetables were based on 20 sets on daily operation with seven out of service to cover maintenance — an availability of 74%.

## East Coast main line

If BR's hopes had been raised by the relatively easy passage of the initial submission, they were soon dashed when the East Coast main line proposal was put to the Department of Transport. This was for a fleet of 42, ten-car (2+8) sets to cover the entire East Coast daytime service. The HST fleet would have replaced the 22 Class 55 'Deltics', some Class 47 diesels, and about 35 sets of Mk 2 stock which would have been cascaded on to the North East-South West cross country axis. Whilst at that time the East Coast had a regular-interval integrated timetable, the combined impact of time and distance meant that the profitability of individual trains varied considerably. Simply stated, a high speed service from King's Cross to Edinburgh, with one or two stops and a good load of passengers, will maximise revenue and minimise unit costs. As earnings (fares) are calculated by distance and, as most operating costs are determined by time, profitability and earning potential are maximised over longer distances — the faster you go the cheaper

Typifying the Western Region HST service is Set No 253.004 hustling through Sonning Cutting with the 16.17 Bristol-Paddington service in August 1981.
*Colin J. Marsden*

*Right:*
A factor in the technical problems with HST was the introduction of 125mph stopping services that were not foreseen when the train was conceived. The 15.35 Paddington-Weston-super-Mare has generated a busy platform at Didcot on 20 April 1985.
*Michael J. Collins*

you go. This was to become a recurring theme in the many subsequent debates on HST deployment.

When the Department's economists got to grips with the fine detail of the submission, they found a good economic case for those trains working the high-profitability services to West Yorkshire, the North East and Scotland. Less attractive were the economics of the trains serving small towns, such as Huntingdon, Grantham, Newark and Retford, where the baseload of potential traffic, and prospects for growth were, admittedly, at that time, small. The Department concluded that, while the rate of return on the premium services fully met their investment criteria, this was not the case so far as these semi-fasts were concerned. Despite the obvious advantages of operating the East Coast service with a single fleet of HSTs, the case for 42 sets was rejected, and authority given for only 32 trains.

In the short term, the Eastern Region was able to live with this situation. So long as they still had a fleet of 'Deltics' in good working order, and with a carefully prepared timetable over the critical section, between King's Cross and Doncaster, a 'Deltic'-hauled 100mph train limited to seven or eight coaches could work the semi-fast services without impeding the passage of the 125mph HSTs. Accordingly, the first East Coast HST service was planned on the basis of a mixed fleet, with the 32 HSTs supported by ten 'Deltic'-hauled conventional trains.

Phase-in of the East Coast HST service was beset with problems. The original plan provided for an initial service between King's Cross, Newcastle and Edinburgh from May 1978, followed by the full service from May 1979. In the event, because of continuing production delays, insufficient sets were available for the start of the May 1978 timetable and the introduction of some services had to be postponed for a few weeks. Although BR had no choice other than to phase-in HSTs as they came off the production line, a train service provided by a mixture of brand new and older equipment was very difficult to sell to its customers. Quite apart from the fact that HST journeys were much quicker, the train had already created a very

favourable public impression. It was comfortable, it rode well, and the catering facilities were a distinct improvement on what was being offered in old Mk 1 vehicles on ordinary trains. Within a couple of weeks, HSTs were running full, with passengers standing, while the locomotive-hauled trains had seats to spare. However, as the ER started to build up its fleet towards the full 32 sets through 1978, the position began to improve.

By the start of 1979, when preliminary planning for the most dramatic step forward in the history of the East Coast route was nearing completion, disaster intervened. On 13 March, during engineering works, the roof of Penmanshiel Tunnel in Scotland collapsed, with the tragic death of two workers, completely severing the northern section of the East Coast route between Berwick and Dunbar. Thanks to excellent co-operation betwen the Scottish Office, the Local Authorities and BR, agreement to build a short diversion round the site of the collapse was soon given and the East Coast main line reopened on 20 August 1979 when the full HST service was introduced.

## West of England

Although the line from London to the West of England by the Berks & Hants route, through Newbury, Westbury, Taunton and Exeter, does not — apart from the 36 miles between Paddington and Reading — offer the prospect of speeds above 100/110mph, a good case was made to bring HSTs on to the route. While WR had to contend with an annual — but declining — summer peak, which in the past had tied up resources for a few critical days each summer, there was a solid baseload of business throughout the year which was showing a reasonable growth. By the mid-1970s, this regular business was under threat from motorway construction and an air service between Plymouth and London. To stay in business, WR needed a package of train service improvements.

Several options were considered. One was pairs of 2,700hp Class 50 diesel locomotives working in multiple, hauling Mk 2 air-conditioned stock which could be provided from existing resources. However, the journey-time savings were only marginal, and fuel costs would have increased to an unacceptable extent. The Class 50s, however, did not have a particularly good reputation for reliability. Even though an HST would not run at its full 125mph potential for the greater part of the journey to the west, its high power/weight ratio and superior acceleration and braking characteristics still offered the prospect of significant journey time reductions. Plans to renew the Berks & Hants line's obsolete semaphore signalling would also allow line speeds to be raised to 100/110mph at a number of locations. Introducing HSTs on the West of England route would enable the WR to operate its enlarged fleet as a single entity with resulting operating savings. The displaced Mk 2 air-conditioned stock would go to East Anglia, replacing older vehicles which could be scrapped. In May 1977, the Department of Transport authorised the build of 14 sets for the West of England. A partial service of HSTs over the Berks & Hants line was introduced in October 1979, with the full service from May 1980.

## North East-South West

It was well into the post-war nationalised era before BR began to develop the full traffic potential of what is known as the North East-South West cross-country route. The route is, in fact, an outward extension of the old Midland Railway's Derby to Bristol main line which is the core of this important axis. Prospects for this route began to improve when BR revised the administrative arrangements for managing its business operations, which had previously involved a large number of different regional offices. By 1972, a small inter-regional management group had introduced a number of important train service improvements built around interchange at Birmingham New Street station. Separate trains from the northwest and northeast converged at Birmingham to make a cross-platform interchange, before going forward to the southwest or South Wales. A similar arrangement applied in the northbound direction. Subsequently, as business developed, the network was extended to include the South Coast, using the route through Oxford and the Thames Valley to Reading, and on to a number of destinations on the Southern Region such as Portsmouth and Poole. At one stage, prospects for both passenger and freight looked so good that the possibility of electrification of parts of the North East-South West route was discussed. The possibility of using displaced East Coast 'Deltics' was considered. This would have been an interim stage since WR felt that the HST would be the best equipment to develop the route.

Between York, Derby and Bristol, there was not the potential for line speeds to be raised much above 100/110mph. Even so, journey times would be significantly reduced. Full 125mph operation would be possible over the East Coast main line section, however. The fleet would be based at a new depot at Plymouth (Laira), with facilities already provided at Bristol, Leeds, Newcastle and Edinburgh for other HST projects also being used. BR's proposed fleet of 36 trains would be introduced in two stages. Stage 1 would cover services from Edinburgh, Newcastle and Leeds to Cardiff, Bristol, Plymouth and Penzance. Stage 2 would extend services to cover Manchester and Liverpool to the West of England and the South Coast plus remaining services for the North East. HSTs would run 'under the wires' between Manchester, Liverpool and Birmingham and over the third rail on the Southern Region. A Dorchester and Poole service was also envisaged.

In 1978 BR sought approval for the first batch of 18 trains with a 2 + 7 formation. This was approved by the Department in June 1978. But by this time the overall outlook for Inter-City services had deteriorated as the national recession began to bite. The Government had also tightened up on nationalised industry investment limits. Stage 2 of the North East-South West HST project was abandoned. The series of technical problems with an earlier build of power cars, plus the cut-back in rate of production, badly delayed the North East-South West implementation dates. An interim service was introduced in November 1981, followed by the full service from May 1982.

## More for ECML

Immediate commercial success for the East Coast HST service meant that from its inception it was dogged by capacity problems. Overcrowding had been anticipated on some key services during the phase-in period, but it was expected that demand would balance-out once the full service was implemented in May 1979. When through running was restored after the Penmanshiel Tunnel collapse, and the full journey time cuts between London and Edinburgh implemented, it soon became clear that the very popular mid-morning Anglo-Scottish trains in both directions were regularly loading to capacity. Also, the two through services from Aberdeen to King's Cross were often full by the time they arrived at Edinburgh. It was clear that the service would need to be strengthened if business was to be retained.

Other issues — the question of HST services to Humberside, Teesside and Sheffield — also began to crystallise. Apart from the pair of 'Hull Executive' limited stop trains, the service to Hull had been provided by alternate semi-fast services. This had been ruled out as an HST duty by the Department of Transport. In the case of Teesside, BR had a good market, with an identified need for two pairs of business services in each direction between King's Cross and Middlesbrough. By running these services directly into Teesside, eliminating the change of train into a local diesel multiple unit, at Darlington, Inter-City services would be able to compete with the Heathrow-Teesside air service. However, Sheffield was the most difficult problem. Compared with other major centres such as Cardiff, Bristol, Darlington and Birmingham, its service to London was poor. The best time between London (St Pancras) and Sheffield was 2½hr — the same time as it took an East Coast HST to reach Darlington, 75 miles further away from London.

To meet these various requirements, the ER prepared a case for seven more HSTs. These would provide: a peak-hour HST between King's Cross and Sheffield in each direction, via Retford and the East Coast main line; two pairs of trains between King's Cross and Middlesbrough; an HST to replace the pair of Hull business trains; plus additional sets for midday Anglo-Scottish services. Scheduling of the additional services would improve fleet utilisation. For example, both the Middlesbrough and Hull morning HSTs would have arrived in King's Cross by 10.00, in time to return as extra mid-morning services to Scotland. Similarly, the extra mid-morning trains from Scotland would have arrived in King's Cross in time to form the afternoon return business services to Middlesbrough, Hull and Sheffield.

Having passed through BR's investment committee without any problems, the East Coast seven-set proposal was put to the Department of Transport in the second-half of 1979. Mainly because of the tighter investment criteria being applied to the nationalised industry, the Department's initial response was to sanction only two of the seven sets requested. BR protested, and after the row over the 'two-for-seven' had become public, formal approval for four sets was given in January 1980. These were to cover the most profitable of the additional East Coast services proposed by BR. On the basis that the Government was not prepared to support what BR felt was a very good case for the 'East Coast seven', the Board decided to terminate the HST production run at 95 operational trains. Even before the outcome of the seven-set proposal was known, BR had already decided not to proceed with the proposed Stage 2 build of 14 sets for the North East-South West route . Also, by now, optimism was growing over the possibility of more electrification — in particular of the East Coast main line. In the event, approval for this was not obtained until July 1984.

Termination of the HST programme coincided with British Rail beginning to feel the effects of the downturn in the economy. From the second quarter of 1980, a steady decline in InterCity loadings began. After peaking at 9,512 million loaded train miles in 1979, the figures fell away to 9,287 million in 1980 and 8,664 million in 1981. Particularly serious for InterCity was the impact of the recession on first class business travel, with the consequent loss of full-fare revenue. A similar decline in optional ticket sales was exacerbated by the intensified competition from long-distance coaches, now largely freed from the constraints of route licensing by the 1980 Transport Act. With little prospect of stimulating first class travel until the recession eased, BR decided to attack the coach competition head-on in the optional market by lowering fares and going for volume business. To some extent this was a risky policy. While lower fares will almost certainly generate more volume, the result is not necessarily a net revenue gain. BR had to be ever-mindful of the 1977 policy document (issued by the outgoing Labour Government) which required BR's Inter-City services to pay their way.

With little prospect of an early economic recovery, BR initiated an examination of load factors and service levels with the aim of bringing capacity in line with a much lower level of market demand. Given that any additional traffic gained from lower fares was unlikely to generate significant extra volume, the gap between revenue and cost could be closed only by a reduction in costs. Early in 1981, BR decided to implement a cut of 10% in loaded train miles, phased in five stages between June 1981 and October 1982. Sensibly, cuts were not applied across the board. Instead they were applied in line with criteria designed to safeguard the long-term future of the InterCity business. Each service was examined on its own merit and route-by-route targets set accordingly. Broadly, only lightly-loaded services, whose passengers could be accommodated on other trains, were withdrawn. The objective was to make maximum cuts with the minimum inconvenience.

Whatever the circumstances, train service cuts are always depressing but, on the positive side, the InterCity business had become tighter and loadings had improved, making it easier for BR to make a case for future investment. These 1982 service reductions had also enabled InterCity to accelerate its coaching stock cascade plan, including the withdrawal of a large number of old steam-heated Mk 1 coaches which were replaced by more modern vehicles. Significantly, mileage cuts on the WR opened up the possibility of transferring some HSTs for work elsewhere.

## Western Region fleet reduced

While all InterCity routes were affected by the need to make train service cuts, the implications for the WR were the most serious. Compared with other regions, the WR has few industrial areas capable of generating a solid baseload of business traffic. However, the impact of the recession and coach deregulation on the optional or leisure market was very serious. To some extent, WR had already underestimated the impact of the M4 motorway on its services to Bristol and, to a lesser extent, to the West of England. This had already made it possible for the WR to release two HSTs to the East Coast route in 1980.

The root of the problem in 1982 was the increased intensity of deregulated coach services, with very low fares, to towns such as Reading, Swindon, Bath, Bristol, Newport and Cardiff. Given the economic circumstances of 1982, with purchasing power curtailed, price, comfort and journey time were the revised order of priority for passengers with low incomes — such as students and senior citizens. The rail/coach fare differential did not justify the one hour saving in journey time between, say, London and Bristol, and the more modern coaches on the routes were very comfortable.

To meet this new situation the WR completely revamped its services on the Paddington-Bristol/South Wales route. Lightly-loaded services were withdrawn, HST availability was raised, and station turn-rounds reduced to something under 30min. These revisions were introduced in two stages in May and October 1982, releasing five HSTs for use elsewhere.

Despite its penetration of a number of major centres, the Midland main line had not enjoyed the same level of investment as other parts of BR. When the modernisation programme began in the late 1950s, the line was an early candidate for diesel

traction. Apart from some Class 47 diesels sent to the route to work the more important business trains, the main motive power for two decades was the Class 45. Passenger comfort was improved in the mid-1970s when Mk 2 air-conditioned stock was sent to the route. Hopes that the Midland line prospects would improve were raised when the route was listed as a candidate in the original HST proposals.

Electrification had seemed a more viable proposal, particularly with the route's many speed-restricted curves well-suited to the electric APT. But by the start of the 1980s, neither electrification nor the APT was any further forward. As improvements to the InterCity services on neighbouring routes, particularly the East Coast main line, gained momentum, criticisms of the Midland service grew. Following representations from the Sheffield City Council, BR looked at the possibility of push-pull working with Class 47s at either end of a set of coaches. This was rejected because the cost of the project exceeded the likely gain in revenue. Another proposal, discussed earlier, was an HST service between Sheffield and London (King's Cross, via Retford). The financial case for an extra set for this purpose was rejected by the Department at the end of 1979. A third proposal, the financial support of an HST service by the Sheffield City Council, was also considered, but terms could not be agreed. Official BR policy was that HST services were not financially viable on the Midland main line.

All this changed, almost overnight, with the creation of business sectors in 1981. Under InterCity Sector Director, Cyril Bleasdale, allocation of the HST fleet became a business matter, and it was clear that the Midland main line would produce a better return from the five 'surplus' WR sets. Because the LMR was preoccupied with the closing stages of St Pancras-Bedford 25kV suburban electrification and the associated resignalling, the new HST service could not start until October 1982. The full Midland HST timetable, introduced in May 1983, required a few remaining locomotive-hauled services. At first it was intended to transfer only the five WR sets to the Midland, but following a critical examination of the Cross Country HST services, and a pair of marginal East Coast services, InterCity concluded that a further five HST sets would be more profitably employed on the Midland main line. Thus, in barely two years, BR had gone from

*Right:*
Simplifying pathing for the 125mph trains among slower traffic on the Western Region is the quadruple tracking of the original GWR main line. This is the 13.35 Paddington-Swindon between Ealing Broadway and West Ealing in April 1984.
*Michael J. Collins*

asking £¼ million for a 32-week one train a day Sheffield-London St Pancras return service, to allocating 10 HSTs to the same route in the interests of economic deployment!

Maximum line speed over the Midland main line is 100mph and, with the exception of an overnight stabling point at Derby, the route has no HST depots.

Limited potential exists for cost-effective line-speed improvements. Major curvatures imposed speed restrictions at Wellingborough (65mph), Market Harborough (60mph), and Wigston North (70mph). With the staged completion of the Leicester resignalling, sections of route have been upgraded from 80/90mph to 100mph, enabling a few minutes to be trimmed from journey times. Interestingly, when Sheffield City Council made its bid to 'sponsor' an HST service, BR ran night-time trials which 'proved' that 2hr 22min was the fastest possible time. One reason for the Council withdrawing its offer was that it believed that 2hr 15min was needed for the service to be commercially attractive. In the 1987 timetable, the 'Master Cutler' is scheduled at 2hr 15min. However, even if sections of the route could be upgraded from 100mph to 110/125mph, the small journey time saving would not justify the extra cost of providing the second driver required for speeds over 100mph, nor could a dedicated Midland line HST depot be justified financially. Given that most of the trains come into service at the northern end of the route, and that Sheffield is only 40 or so miles from Leeds, Neville Hill was the logical base for these trains. This also made it possible for the Midland sets to share part of the maintenance cover with the East Coast sets at Neville Hill, improving overall utilisation. To provide trains starting at the London end, Bounds Green depot on the ER was chosen. Early in the morning and late at night, two of the Midland HSTs make their way across North London over the Tottenham & Hampstead line which connects with the ER at Harringay.

Transfer of the five WR and five Cross Country sets to the Midland created a train formation problem. These sets had only seven trailer vehicles, whereas eight would be required to cope with the level of business on the Midland. Also, the Cross Country sets had only one first class coach and two would be needed. This was resolved by an extra build of 19 Mk 3 trailer vehicles to bring the 10 Midland sets up to 2+8 formation and to replace the 16 TRUK kitchen vehicles which became spare when the two-car East Coast catering format was abolished.

As part of the cost-reduction strategy set out in the document *InterCity into profit*, published in December 1984, WR took steps to improve the financial performance of its HST services. On the Western Region, the short 2+7 HST formations and the cost of running big stations like Bristol and Exeter without financial support from a Passenger Transport Executive gives InterCity services a higher cost base than other routes. Given this, and the loss of business to the M4, further action was necessary to contain the financial situation and restore viability. Over the previous few years, InterCity resources on the Western had already been reduced by 20%. Marginal mileage cuts were introduced in May 1986, but the key to a more cost-effective service was to increase train formations on the West of England route and prime business services. In a revised timetable most of these services were covered by 10 HSTs reformed into 2+8 sets with an extra trailer second vehicle. Originally HST set maintenance was planned on the basis that both power and trailer cars would operate on a common maintenance cycle, although, in practice, trailer cars have a higher availability potential than power cars. By reducing the pool of trailer vehicles for maintenance it was possible to provide sufficient extra cars to form ten 2+8 sets. To make this change, some first class cars were modified to second class configuration. The WR HST fleet retains 21 sets in 2+7 formation.

Modifications to Western HST depot facilities were necessary to cope with the longer sets. At Laira depot, where the 10 2+8 sets are now based, longer fuelling lines had to be installed. Old Oak Common depot was extended at a cost of £2 million. This expenditure was part of a larger project involving the closure of Southall depot and the transfer of its diesel multiple units to Old Oak Common. Modifications to handle 2+8 sets at St Philips Marsh depot, Bristol, was deferred to a later date.

The latest changes in the deployment of the HST fleet have reflected the growing importance of business management in the InterCity Sector. In May 1987 two sets were transferred back

*Below:*
Typical of the early morning business trains is the 07.05 Swansea-Paddington, seen here passing Brymmer in June 1983.
*Michael J. Collins*

*Left:*
Passengers in this Reading-Paddington DMU could have got to London many minutes earlier by catching the passing South Wales-Paddington HST at its Reading stop. This is Ruscombe, just east of Twyford, in April 1986. *Michael J. Collins*

*Below:*
The 16.02 Cardiff-Paddington train leaves Newport over the Usk Bridge on its way to England. *Colin J. Marsden*

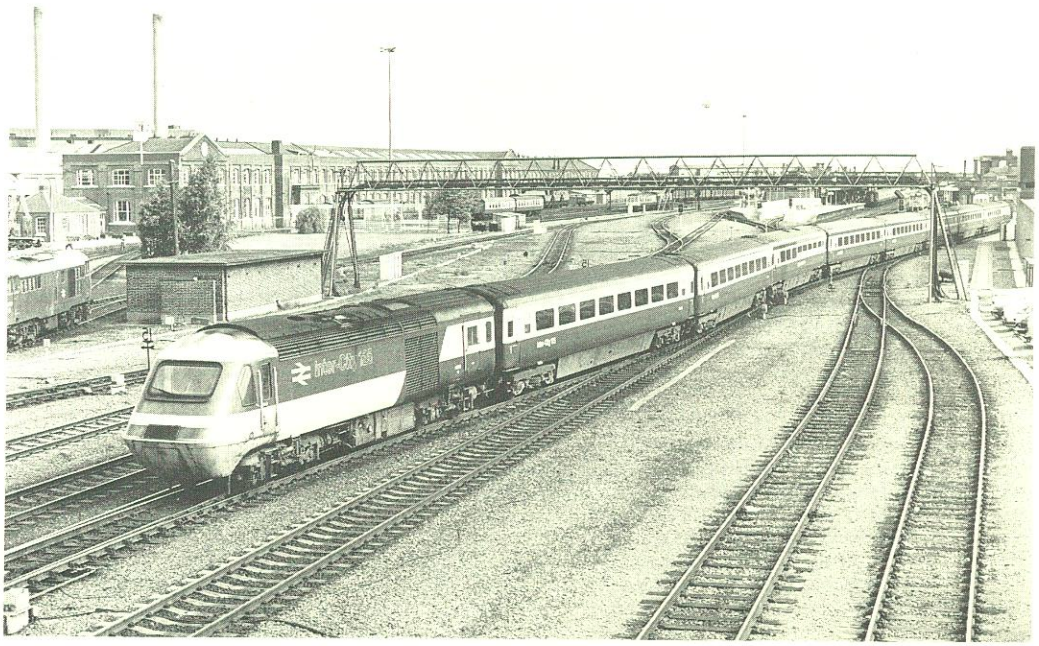
from East Coast main line to Cross Country duties. This was done to minimise InterCity's dependence on costly locomotive haulage by Class 47 diesels, particularly on long journeys. By shedding some poorly-patronised marginal East Coast services, two sets were released. The sets involved remained at Heaton depot, Newcastle, where they shared maintenance cover with the East Coast main line units based there. As well as achieving a worthwhile cost reduction, the two extra sets allowed the acceleration of a number of important Cross Country services, including two hours off the journey between Newcastle and Penzance.

However, in the event the increase in the Cross Country allocation only lasted for the 1987-88 timetable year. In May 1988 Cross Country gave up two HST sets — one for the Midland main line and the other for the Great Western sub-Sector. The reasons for this change — which are more fully discussed in a later chapter — follow an increase in long distance commuting. This started to become popular on the Paddington-Swindon-Thames Valley corridor where house prices were lower than those in districts closer to London, but where 125mph rail journeys offset the effect of the longer distances. Long distance commuting for distances up to 100 and even 150 miles from London is now a feature of all InterCity routes. Didcot, Swindon, Bristol Parkway, Bath, Wellingborough, Market Harborough, Peterborough, Grantham, Newark, Retford and even Doncaster are now seen as growing commuter areas for people working in London.

Redeployment of the two units made it possible for InterCity completely to revamp the Midland main line service with a standard interval pattern in each direction between St Pancras and Leicester and to introduce a 15min morning peak interval service from Swindon to Paddington — a business-led decision.

Inter-City 125
FROXFIELD BOTTOM LOCK

*Above left:*
The Berks & Hants line follows the alignment of the Kennett & Avon Canal for several miles. Passing Foxfield Bottom Lock is the 07.25 Penzance-Paddington HST in July 1984.
*Michael J. Collins*



*Left:*
The 11.39 Edinburgh-King's Cross service passing Ranskill at speed in April 1981. *Colin J. Marsden*

*Above:*
At around 270 miles in length and well-aligned for high speed, the London-Newcastle route is ideally suited for commercially attractive HST operation. In April 1984 the southbound 16.10 to London (left) and a northbound King's Cross-Edinburgh service prepare to leave Newcastle Central.
*Michael J. Collins*

*Centre right:*
The 08.00 Hull-King's Cross regains the main line after a stop at Doncaster in June 1984.
*Michael J. Collins*

*Right:*
Crossing the River Don on the approach to Doncaster is the 08.40 Newcastle-King's Cross train in June 1984. *Michael J. Collins*

*Above right:*
The generous ballasting which contributes to the high ride standards on the Western Region (and suggestions of profligacy by other regional civil engineers) is well displayed in this view of the 14.45 Paddington-Paignton rounding Wolf Hall curve on the Berks & Hants line. *Michael J. Collins*

*Right:*
Comparison of power car exhausts hints at problems with the fuel system of the leading power car as the 13.40 Penzance-Paddington negotiates Dawlish Warren in July 1985. *Michael J. Collins*

*Below:*
The 09.03 Penzance-Paddington at Dawlish in October 1980 with a particularly clean No 253.036 in the lead. *Colin J. Marsden*

*Above:*
With the exhaust from the leading Valenta diesel engine so clean as to be a mere heat haze, the 14.15 Paddington-Paignton pulls away after its stop at Dawlish in August 1985. The rear exhaust is more visible, one reason being that the leading engine will have been running at part load during the station stop to supply power for the train's auxiliaries. *Michael J. Collins*

*Left:*
The characteristic corrugated roof of the Mk 3 coach, which gives extra strength to the thin steel sheet, is shown to good effect in this study of the 09.25 from Paddington approaching Teignmouth station in October 1980. *Colin J. Marsden*

*Right:*
The down 'Cornish Riviera Express' runs on to some newly laid track at Burngullow West in June 1980. *Colin J. Marsden*

*Below:*
Set No 253.014 with a Paddington-Penzance service passes Aller Junction in August 1980. *Colin J. Marsden*

*Facing page, top:*
The 13.46 Penzance-Paddington service at Dobwalls in May 1985. *Colin J. Marsden*

*Facing page, bottom:*
The 12.45 Paddington-Plymouth service accelerates through Fairwood Junction after its stop at Westbury on 23 October 1986. *Michael J. Collins*

CHAPTER FIVE

# A Scarce Resource

Preparation of the daily work schedules (known in railway parlance as diagrams) for the HST fleet is a basic part of BR's on-going timetable production cycle which brings together the basic elements of times, frequencies, availability of equipment, crewing and line terminal and depot capacity. Starting point for each timetable cycle is the train service specification prepared by the InterCity Route Manager. This covers such details as the type of equipment to be used (HST or locomotive-hauled stock for instance), frequency of the service, stations to be served, catering facilities and the times of the first and last trains. It is the role of the production side of the railway to translate the train service specification into a viable working plan — the timetable.

BR's timetable production teams are part of the Regional Operations Manager's organisation. They are a highly-skilled group, with a particular aptitude for resolving complex logistical problems which are the basic challenge of running a railway. In recent years, given the conflicting aspirations of the five sectors and the need to obtain even more work from reducing resources, their basic task has become more challenging. Fortunately, other changes have made it easier. During the day the Western and East Coast routes now carry very little low-speed freight traffic and, to a considerable extent, the HSTs have exclusive use of the main lines to exploit their full speed potential. Finding paths for high-speed trains through busy centres such as Reading, Taunton, Doncaster and York is no longer the problem it was. Even so, timetabling HSTs into and out of Paddington and King's Cross during the critical 16.30 to 18.00 period, when the home-going commuter and InterCity peaks coincide, continues to pose a number of capacity problems.

To the greatest extent, the structure of InterCity services has been based on the regular-interval concept, with intensively used trains running throughout the day and a flexible pricing policy designed to sell off-peak seats to leisure travellers. This concept has two strengths. Passengers prefer the ease of access offered by a simple repetitive timetable, which can be committed to memory, and the railway is able to maximise the use of its rolling stock and infrastructure resources. Matching rolling stock and crew diagrams with a timetable is also very much easier if there is a regular pattern of trains in each direction. Unfortunately, because of the impact of the recession and coach deregulation, business on some routes fell below the level sufficient to support an hourly service throughout the day, and the interval was extended. This has created two difficulties. In some cases — where an hourly service is excessive and a two-hourly service is insufficient — a compromise 90min headway had to be adopted, but it may not always be possible to establish a precise interval.

The HST encourages intensive utilisation. Locomotive 'run-round' at terminal stations is eliminated and standing time minimised. At Gloucester and Nottingham, HSTs routinely reverse their direction of travel in 5min to 7min, the minimum time needed for the driver to walk to the opposite end of the train. While the speed of the HST was a major attraction for the marketing department, it offered equally exciting opportunities for the train planners. Here was a train which could run from Paddington to Bristol in 1hr 35min, turn round in 25min, and be back in Paddington to start another round trip, all within 4hr. If it came off depot early enough, it could complete as many as eight single trips, totalling around 950 miles, within a normal working day. On the longer East Coast main line the opportunities were even greater. An early business service from Leeds or Newcastle could be into King's Cross around 09.00, early enough for the train to make a return trip to Edinburgh and back in the same day. This was impossible with 100mph traction and locomotive-hauled stock.

However, a fixed-formation high-speed train, particularly if it is diesel-powered, does have operating constraints. Its inability to cope with short-term traffic fluctuations, such as Friday evenings or Bank Holiday weekends, is a serious disadvantage. Although an additional vehicle can be attached to an HST set, this movement is usually possible only in an HST depot. But by rearranging maintenance schedules higher peak-period availability can be achieved making more sets available for weekend peaks.

Diesel traction also imposes constraints. The range of an HST at speeds over 100mph is around 1,100 miles, making daily refuelling necessary. Each train must also have an 'A' examination every 48hr, extendible to a maximum 72hr or 2,500 miles, and a 'B' examination every 35 days. A 'B' examination takes two full days out of service.

Today, in a railway which is 'resource' rather than 'market' led, the train planners draft a timetable on a predetermined number of operational trains instead of planning a full service timetable and then calculating the number of trains required. A key decision in the train planning process is the allocation of diagrams to each of the depots supplying the trains to work the service. British Rail's seven HST depots are all close to important terminal stations in the network, where trains start or conclude their day's work. Each depot's allocation of sets has to cover its daily diagrams, with one or more spare sets to cover periods when trains are out of service, either for a 'B' examination or because of a failure. In addition, each depot has a float of spare power cars and trailers to replace single vehicles which may have to be repaired. Each depot is responsible for the maintenance of its own basic allocation. All 'B' examinations will be undertaken at the base depot, but 'A' examinations may be made at other depots.

HST deployment by the Great Western sub-Sector is determined by the morning peak service from the provinces to Paddington, and this factor decides the total size of the fleet. In contrast to the East Coast main line service, where the morning business trains to King's Cross can be turned back as well-loaded mid-morning leisure trains to Scotland, the off-peak service down to Bristol and South Wales can be covered by two trains per hour in each direction. This affords an opportunity to use some sets for midday leisure trips in marginal time to destinations such as Worcester, Great Malvern, Straford-upon-Avon and Paignton.

To maximise its revenue-earning potential, the HST fleet has to be utilised fully during a working day running from around 06.00 through to 23.00. It is impossible for every unit to start and

finish at its base depot with this intensity of working. Other factors complicate allocation. For example, Laira depot (Plymouth), which has the extra siding space to hold the 2+8 sets used on the West of England route, is the logical place to base these trains. But how can Plymouth-based sets be positioned to cover morning business services at 05.19 from Penzance, 06.37 from Swansea and 08.00 from Paddington? The answer is a series of workings known as 'cyclic diagrams'. These ensure that specific sets are at the right location at the start of each day. Each unit's starting position is determined by its concluding trip on the previous day's working cycle. For example, the 06.37 from Swansea is provided by the unit which has worked the 17.59 from Paddington to Swansea on the previous evening.

As far as possible, both the operators and depot maintenance staff prefer to keep diagram cycles as short as possible. Inevitably, depot staff will take more care with their own units, and depot engineers like to have their hands on their own trains as often as possible. Multi-day cycles are also a particular problem for the catering staff. Each HST catering vehicle carries a stock of perishable and non-perishable food which has to be checked and rechecked every time the catering crew is changed, sometimes two or three times a day. However, this particular problem will be resolved when the HST fleet changes to the Cuisine 2000 modular catering system.

*Table 1* sets out a two-day cycle for the 1988-89 timetable for a 2+7 TRB set based at Old Oak Common. Because of the increasing number of trains which have to be provided to cover the morning peak service to Paddington, this unit has to start its cycle with an empty trip from Old Oak Common to Bristol. Most of the work is on the South Wales route, but there is an evening run from Paddington to Taunton and back. Overnight fuelling is at Landore (Swansea) and an A Exam is carried out at Old Oak Common at the end of the second day. *Table 2* shows a far more complicated position. Partly to ensure equal mileage accumulation, but also to give sufficient time between each day's work, all 10 Bounds Green 2+8 TRFB sets are worked through a 10-day cycle. During this period, sets are fuelled at Aberdeen, Newcastle, Bounds Green, Heaton and Leeds; 'A' examinations are made at Bounds Green (twice), Neville Hill (twice) and Heaton (once). Particular points of interest are the 06.15 Peterborough to King's Cross commuter service and the overnight 'Nightrider' (day 7) at 23.23 from King's Cross to Edinburgh.

**Table 1**
*OLD OAK COMMON 2+7 TRB SET: 1988-89*

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | Old Oak Common Depot | | — | — | — |
| | Bristol Temple Meads | | — | 06.46 | E |
| | Paddington | | 08.20 | 09.00 | 118 |
| | Swansea | | 11.39 | 12.41 | 191 |
| | Paddington | | 15.26 | 16.35 | 191 |
| | Swansea | | 19.21 | — | 191 |
| | Landore Depot | F | — | — | E |
| 2 | Swansea | | — | 07.41 | — |
| | Paddington | | 10.21 | 11.00 | 191 |
| | Swansea | | 13.46 | 14.41 | 191 |
| | Paddington | | 17.27 | 18.05 | 191 |
| | Taunton | | 20.43 | 21.10 | 164 |
| | Paddington | | 23.39 | — | 164 |
| | Old Oak Common | F, 4 | — | — | — |
| | | | | Total | 1,592 |

**Table 2**
*BOUNDS GREEN 2+8 SET: 1987-88*

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | King's Cross | | — | — | — |
| (Mon) | Peterborough | | — | 06.15 | E |
| | King's Cross | | 07.29 | 08.45 | 76 |
| | Leeds | | 11.14 | 11.45 | 186 |
| | King's Cross | | 14.14 | 16.00 | 186 |
| | Aberdeen | F | 23.23 | — | 524 |
| 2 | Stonehaven | | — | 07.20 | E |
| (Tues) | Aberdeen | | 07.41 | 08.00 | 16 |
| | King's Cross | | 15.11 | 16.30 | 524 |
| | Newcastle | F, A | 21.03 | — | 294 |
| 3 | Newcastle | | — | 05.30 | — |
| (Wed) | King's Cross | | 09.51 | 11.35 | 294 |
| | Edinburgh | | 16.42 | 17.35 | 394 |
| | King's Cross | F | 22.40 | — | 394 |
| 4 | King's Cross | | — | 06.15 | — |
| (Thur) | Aberdeen | | 14.25 | 16.00 | 524 |
| | King's Cross | F, A | 23.42 | — | 524 |
| 5 | King's Cross | | — | 08.00 | — |
| (Fri) | Edinburgh | | 12.50 | 13.35 | 394 |
| | King's Cross | | 18.28 | 19.30 | 394 |
| | Leeds | | 22.02 | — | 186 |
| 6 | Hull | F | — | 07.00 | E |
| (Sat) | King's Cross | | 09.42 | 10.30 | 197 |
| | Leeds | | 13.12 | 13.45 | 186 |
| | King's Cross | | 16.10 | 17.30 | 186 |
| | Newcastle | E | 20.51 | 21.36 | 269 |
| | Leeds | F, A | 23.23 | — | 109 |
| 7 | Neville Hill | | — | — | — |
| (Sun) | Bradford | | — | 07.59 | E |
| | King's Cross | | 12.27 | 13.35 | 196 |
| | York | | 16.32 | 17.15 | 189 |
| | King's Cross | | 20.00 | — | 189 |
| | Ferme Park | F | — | 22.05 | E |
| | King's Cross | | 22.42 | 23.23 | — |
| 8 | Edinburgh | | 06.27 | — | 394 |
| (Mon) | Craigentinny | C | — | 08.31 | — |
| | Edinburgh | | 08.37 | 09.00 | — |
| | King's Cross | | 14.05 | 15.50 | 394 |
| | Harrogate | | 18.47 | 19.04 | 204 |
| | Neville Hill | | 19.44 | — | E |
| | | F, A | | | |
| 9 | Harrogate | | — | 09.11 | — |
| (Tues) | King's Cross | | 12.10 | 13.35 | 204 |
| | York | | 16.00 | 16.37 | 189 |
| | King's Cross | | 19.10 | 20.00 | 189 |
| | Newcastle | F | 23.26 | — | 269 |
| 10 | Newcastle | | — | 09.40 | — |
| (Wed) | King's Cross | | 13.10 | 14.50 | 269 |
| | Leeds | | 17.20 | 17.55 | 186 |
| | King's Cross | F, A | 20.30 | — | 186 |
| | | | | Total | 8,915 |

The recent introduction of Pullman services on HST routes has added a further constraint. Because of their unique formations, their need for special overnight cleaning and maintenance consistent with their status as premium services, plus the need to carry a more extensive range of food and drink, the operational range of Pullman sets is restricted. They must be in a position to cover the morning and evening services, but can be used on fill-in journeys during the day where passengers also have Pullman service. There were three self-contained Pullman diagrams for the 1987-88 timetable — two at Neville Hill and one at Heaton — where the sets return to their base depot every

night. With the partial changeover to electric haulage on the East Coast main line from October 1988, the 'Yorkshire Pullman' workings were completely revised. As far as the 'Yorkshire Pullman' is concerned, the details in *Table 3* are in respect of the 1987-88 timetable (the last full year of HST working between King's Cross and Leeds); the details for the 'Tees-Tyne Pullman' and 'Master Cutler Pullman' are those for 1988-89. Pullman services were extended to the Great Western sub-Sector from October 1987 when the 'Golden Hind' was upgraded; the service was organised by devising a self-contained diagram based on Laira depot with a midday fill-in to Worcester and back. The success of Pullman services was one of the factors leading to the decision to transfer an HST from the Cross Country to the Great Western sub-Sectors for the 1988-89 service. Using three Laira-based 2+8 TRUB sets, the Great Western now operates a total of four pairs of full Pullman services based on one self-contained roster and a two-day cycle which includes some non-Pullman services. (See *Table 5*.)

The complexity of HST diagramming is illustrated in *Table 4*. This shows the number of basic 1987-88 diagrams (excluding the additional Friday services) for each depot, together with the overnight stabling. Laira depot has eight diagrams for the Great Western routes, of which one stands overnight at Cardiff, one at Swansea, three at Laira and three at Penzance. The biggest workload is at Neville Hill with eight diagrams for the East Coast main line and 10 for the Midland main line; during the night it handles a total of 13 sets — nine of its own — plus one each from Bounds Green, Craigentinny, St Philips Marsh and Heaton.

**Table 3**

*YORKSHIRE PULLMAN: (Monday to Friday)*
*Formation:* PC, 2TF, TRFK, TF, TRFB, 2TS, TGS, PC
1987-88

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | Leeds | | — | 07.15 | — |
| | King's Cross | | 09.27 | 11.30 | 186 |
| | Leeds | | 13.57 | 14.45 | 186 |
| | King's Cross | | 17.12 | 17.50 | 186 |
| | Bradford | | 20.41 | 21.01 | 196 |
| | Neville Hill | A, F | 21.40 | — | E |
| | | | | Total | 754 |

*TEES-TYNE PULLMAN: (Monday to Friday)*
*Formation:* PC, 2TF, TRFK, TF, TRFB, 3TS, TGS, PC
1987-88

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | Newcastle | | — | 06.52 | — |
| | King's Cross | | 09.53 | 10.35 | 269 |
| | Hull | | 13.24 | 14.00 | 197 |
| | King's Cross | | 16.46 | 17.30 | 197 |
| | Newcastle | A, F | 20.39 | | 269 |
| | | | | Total | 932 |

*MASTER CUTLER PULLMAN: (Monday to Friday)*
*Formation:* PC, 3TF, TRFM, 3TS, TGS, PC
1988-89

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | Neville Hill | | — | — | — |
| | Sheffield | | — | 07.20 | E |
| | St Pancras | | 09.35 | 10.35 | 167 |
| | Sheffield | | 13.05 | 13.47 | 167 |
| | St Pancras | | 16.19 | 17.05 | 167 |
| | Sheffield | | 19.23 | — | 167 |
| | Neville Hill | F, A | — | — | — |
| | | | | Total | 668 |

*Below:*
Finite resource — the frame of power car No 43198, the last to be built, on the new-build line at Crewe in February 1982. *Colin J. Marsden*

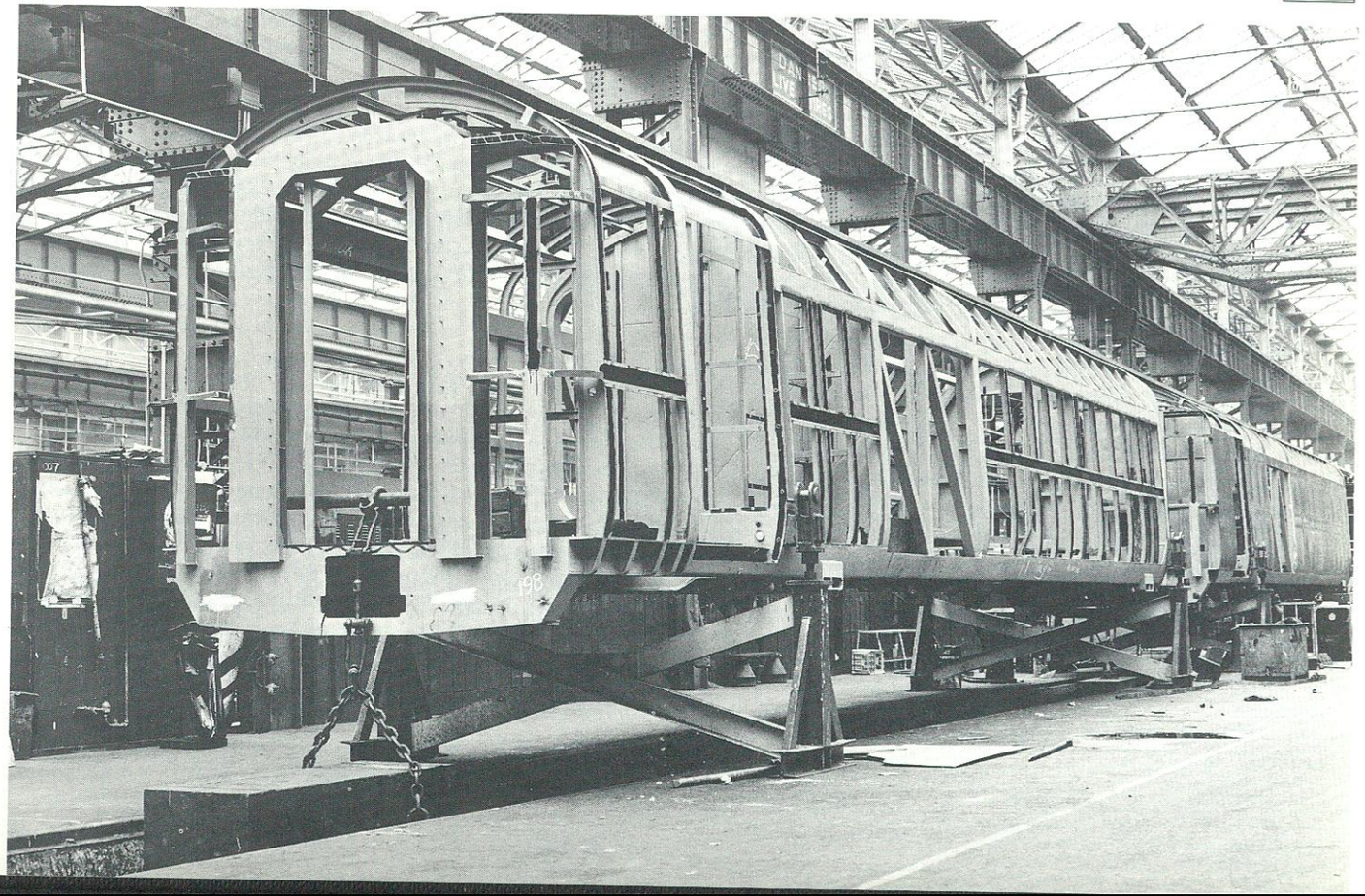


**Table 4**

*INTERCITY HST FLEET OVERNIGHT DISPOSAL*
*(Monday to Friday: Basic Service 1987-88)*

| *Route (Diagrams)* | *Depot* | *Depot Diagrams* | *Overnight Stabling Points* | | | | | | | | | | | | | | | | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | OOC | SPM | CD | SW | LA | PNZ | BG | CLE | HL | DY | NH | HT | EC | AN | IN | IS | |
| Great Western 26 | LA | 8 | | | 1 | 1 | 3 | 3 | | | | | | | | | | | 8 |
| | SPM | 10 | | 5 | | 3 | | | | | | | | | | | | 2 | 10 |
| | OOC | 8 | 3 | 1 | 2 | 1 | 1 | | | | | | | | | | | | 8 |
| ECML 29 | BG | 10 | | | | | | | 4 | | 1 | | 1 | 2 | | 1 | | 1 | 10 |
| | NH | 8 | | | | | | | | 1 | 1 | | 5 | 1 | | | | | 8 |
| | HT | 7 | | | | | | | 1 | | | | | 3 | 1 | 1 | | 1 | 7 |
| | EC | 4 | | | | | | | | | | | 1 | | 2 | | 1 | | 4 |
| MML 10 | NH | 10 | | | | | | | 2 | | | 4 | 4 | | | | | | 10 |
| Cross Country 12 | LA | 6 | | 1 | | | 3 | 1 | | | | 1 | | | | | | | 6 |
| | SPM | 2 | | 1 | | | | | | | | | 1 | | | | | | 2 |
| | HT | 4 | | | | | | | | | | 1 | 1 | 2 | | | | | 4 |
| 77 | | 77 | 3 | 8 | 3 | 5 | 7 | 4 | 7 | 1 | 2 | 6 | 13 | 8 | 3 | 2 | 1 | 4 | 77 |

*Key*

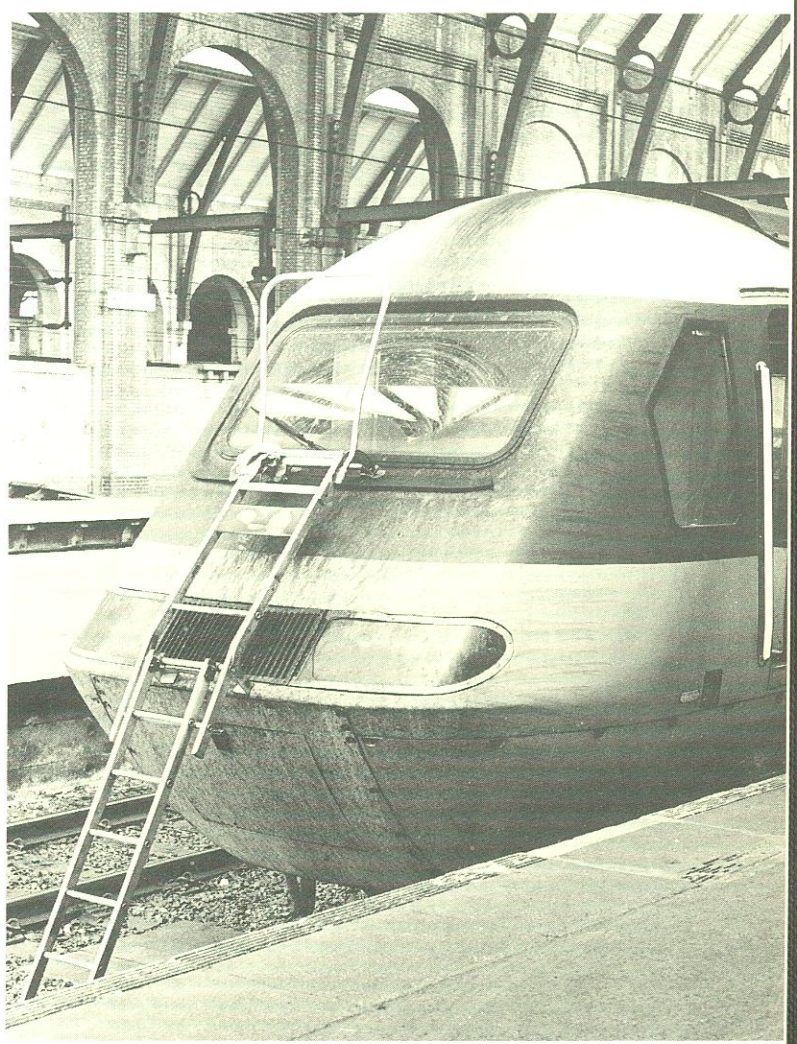
| | | | | | |
|---|---|---|---|---|---|
| LA | Laira (Plymouth) | HT | Heaton (Newcastle) | HL | Hull |
| SPM | St Philips Marsh (Bristol) | EC | Craigentinny (Edinburgh) | DY | Derby |
| OOC | Old Oak Common (London) | CD | Cardiff | AN | Aberdeen |
| BG | Bounds Green (London) | SW | Swansea | IN | Inverness |
| NH | Neville Hill (Leeds) | PNZ | Penzance | IS | Train in service at night |
| | | CLE | Cleethorpes | | |

**Table 5**

*GREAT WESTERN PULLMAN 2+8 SETS: SUMMER 1988*

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | Penzance | | — | 05.19 (1) | — |
| | Paddington | | 10.00 | 10.40 (2) | 305 |
| | Stratford-upon-Avon | | 12.37 | 14.31 (2) | 123 |
| | Paddington | | 16.33 | 17.45 (1) | 123 |
| | Penzance | F, A | 22.38 | — | 305 |
| | | | | Total | 856 |
| 1 | Swansea | | — | 06.37 (3) | — |
| | Paddington | | 09.13 | 10.10 | 191 |
| | Plymouth | | 13.35 | 14.20 | 245 (5) |
| | Paddington | | 17.48 | 19.00 | 245 (5) |
| | Plymouth | | 22.29 | — | 226 |
| | Laira Depot | F, A | — | — | — |
| 2 | Plymouth | | — | 05.38 | — |
| | Paddington | | 09.04 | 09.50 (4) | 245 (5) |
| | Paignton | | 12.48 | 14.05 (4) | 221 |
| | Paddington | | 17.03 | 17.59 (3) | 221 |
| | Swansea | | 20.40 | — | 191 |
| | | | | Total | 1,785 |

(1) 'Golden Hind Pullman'.
(2) 'Stratford-upon-Avon Pullman'.
(3) 'Red Dragon Pullman'.
(4) 'West Country Pullman'.
(5) Train runs via Bristol.



*Right:*
A particularly dirty nose-end ready for cleaning at King's Cross. 'Widow's peak' is caused by exhaust fumes entrained in boundary layer when a power car runs at the rear of the train. The sheet-metal deflector, designed to minimise this effect can be seen on the roof.
*Michael J. Collins*

**Table 6**

*HST VEHICLE DEPLOYMENT: MAY 1988*

| *Depot* | *Sub-Sector* | *Trailers* | | | *Catering vehicles* | | | | | | | *DVT* | *Power cars* | *Sets* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *TF* | *TS* | *TGS* | *TRB* | *TRUB* | *TRFB* | *TRSB* | *TRFK* | *TRF* | *TLUK* | | | |
| Old Oak Common | Great Western | 16 | 24 | 9 | | | | 8 | | | | | 17 | 8 |
| Laira | Great Western | 22 | 44 | 11 | | 10 | | 1 | | | | | 16 | 11 |
| | Cross Country | 6 | 25 | 7 | | | | 7 | | | | | 19 | 6 |
| Bristol St | Great Western | 26 | 39 | 14 | 10 | | | 4 | | | | | 34 | 13 |
| Philips Marsh | Cross Country | 6 | 24 | 6 | | | | 6 | | | | | 6 | 6 |
| Bounds Green | East Coast | 41 | 82 | 23 | | | 20 | | | | | 4 | 16 | 20 |
| | Charter | | | | | | | | | | 1 | | | |
| Craigentinny | East Coast | 10 | 20 | 5 | | | 5 | | | | | | 20 | 5 |
| Heaton | East Coast | 3 | 2 | 1 | | | 1 | 1 | 1 | | | | 10 | 1 |
| Neville Hill | East Coast | 17 | 30 | 8 | | | 9 | | 2 | | | | 27 | 8 |
| | Midland ML | 27 | 51 | 14 | | | 12 | | | 1 | | | 28 | 13 |
| | Totals: | 174 | 341 | 98 | 10 | 10 | 47 | 27 | 3 | 1 | 1 | 4 | 193 | 91 |

*Note:*
With the introduction of the new Cost Effective Maintenance (CEM) policy in 1987/88 power cars and trailer vehicles were allocated separately to Level 5 maintenance depots rather than as complete sets to operating depots.

*Vehicle code*

**TF** Trailer First Class
**TS** Trailer Standard Class
**TGS** Trailer Guard Standard Class
**TRB** Trailer Buffet Unclassified
**TRUB** Trailer Restaurant Unclassed Buffet
**TRFB** Trailer Restaurant First-Class Buffet
**TRSB** Trailer Restaurant Standard-Class Buffet
**TRKF** Trailer Restaurant Kitchen First
**TRF** Trailer Restaurant First
**TLUK** Trailer Lounge Unclassed Kitchen

*Table 6* shows vehicle deployment for 1988-89.

Turn-round times at terminal stations are an important consideration in HST scheduling and diagramming. Short turn-rounds enable the trains to keep on the move and maximise their earning potential, but unrealistically-close turn-round times can cause chaos if the service is interrupted. In a worthy effort to maximise utilisation, so that some sets could be moved to other routes, the WR reduced turn-round times to as little as 20min at some key stations. Unfortunately, the timetable involved was that for the very hot summer of 1983 which precipitated the outbreak of power car failures. The effect of the failures on performance was exacerbated by the short turn-rounds. After ten years experience with HSTs, the regions have a good feel for the practicalities of each route and what is an acceptable turn-round margin.

Distance is an important factor. A train from Penzance to Paddington, or Inverness to King's Cross is more likely to be delayed than a train on a short journey from Paddington to Bristol. Preferred turn-rounds on the Western are 20min at Bristol, 40min at Swansea and Penzance and 20/30min at Paddington for trains arriving from Bristol. For trains arriving at Paddington from Swansea or Penzance, 40-45min is preferred. Similar considerations apply on the East Coast main line but, with the start of the May 1987 timetable, the policy at King's Cross changed. Although it is possible for the station staff to prepare a train for its return journey within the previous turn-round times, this could be achieved only by holding passengers in queues until a few minutes before departure time. To improve services, the InterCity Sector decided to extend all King's Cross turn-round times to eliminate queuing. This was achieved by replacing a return HST King's Cross to Hull service by a locomotive-hauled train. This small loss of HST time was offset by an improved quality of service.

In HST's first decade, the programming of the fleet has been developed well beyond what was originally envisaged and reached its peak in the 1987-88 timetable, the last full year in the East Coast main line. As electric working is extended HSTs will be cascaded to other routes. Originally, standard formations were intended for each route, but this changed as the market evolved with the passage of time. Similarly, as technical performance has improved, the availability figures have moved up slowly. At first, in 1976/77, the WR fleet was programmed for 74% availability, but this had risen to almost 77% by 1982. For the 1987/88 timetable, the figure was up to 83.9%. The link between the availability, revenue-earning power and the bottom line results of the InterCity Sector needs no emphasis.

That BR has been able to increase the utilisation of the HST fleet at the same time as accepting additional programming constraints is a considerable achievement. Part of this is because of the improved technical performance (*see Chapter 6*), but a significant contribution has come from skilful programming and, in particular, the use of 'marginal time'. Marginal time — the concept of using a resource outside its usual or intended sphere of operation — can best be explained within the context of the East Coast main line. The Edinburgh-King's Cross HST service is a commercially justified, high-speed, hourly service and requires a given number of units to cover all of the workings. Each set takes about 10hr to make a return trip. At the Edinburgh end of the route, nine HSTs are needed to cover departures from 06.55 through to 12.30. By this time the first of the hourly sequence from King's Cross, which arrives at 12.30, is available for the return working in the hourly sequence at 13.30. As the last HST from Edinburgh back to King's Cross is at 18.30, all HSTs arriving in Edinburgh after 17.28 can be used for other work, provided they can be fed into the following morning's sequence of departures up to and including the 12.30. This use of

marginal time was written into the original East Coast HST service to produce two through trains between Aberdeen and King's Cross. In the light of experience, ScotRail has used marginal time to extend HSTs through to Glasgow, Inverness and Aberdeen.

One of the sets which stands overnight in Aberdeen is used for a local commuter service from Stonehaven to Aberdeen before it starts its journey to King's Cross at 07.55. Other examples of marginal time utilisation are the 06.15 and 07.18 commuter trains from Peterborough to King's Cross, which are fitted in before the sets start their normal East Coast work out of King's Cross.

While the basics are common, the detailed utilisation reflects the business characteristics of each route. Very early business journeys from the provinces to London — which to a significant extent have been generated by the HSTs — are conducive to good utilisation. On the WR, very early starts, such as 05.52 from Bristol arriving in Paddington at 07.31, make it possible for the stock to turn-round as the 08.00 from Paddington to Swansea — itself an early start for London passengers going to South Wales. Similarly, the 05.50 from Newcastle, is into King's Cross early enough to cover the 10.00 back to Aberdeen. For Anglo-Scottish trains, the norm is for an HST to make a 786-mile return trip between King's Cross and Edinburgh, plus a preceding or following third leg. The set working the 05.50 from Newcastle to King's Cross, for example, then makes a return trip to Edinburgh and back (10.00 from King's Cross and 15.30 from Edinburgh), a very satisfactory 1,054 miles working day. This is very close to the maximum operating range. Another feature of the East Coast service worthy of note is the diagramming of sets for the 'Cleveland Executive', 'Humber-Lincs' and 'Hull Executive' services. As the market for these trains needs an early start to King's Cross and a late afternoon return to Middlesbrough, Hull and Cleethorpes, the sets covering these trains can be intensively programmed throughout the rest of the day.

Despite a maximum speed of 100mph, and the relatively short distances involved, the 11 Midland sets manage to cover a large number of services during the day. Because of the distances involved, and the complex journeys with numerous intermediate stops, daily mileages for Cross Country HST diagrams are much lower. A St Philips Marsh two-day diagram cycle illustrates the type of work on the Cross Country axis (*Table 7*).

**Table 7**

*CROSS COUNTRY 2+7 TWO-DAY CYCLE*

| *Day* | *Terminal* | | *Arr* | *Dep* | *Miles* |
|---|---|---|---|---|---|
| 1 | St Philips Marsh Depot | | — | — | — |
| | Bristol Temple Meads | | — | 06.16 | — |
| | Liverpool | | 09.45 | 10.30 | 172 |
| | Exeter | | 14.54 | 16.23 | 247 |
| | Leeds | | 21.50 | — | 278 |
| | Neville Hill Depot | F, A | — | — | — |
| 2 | Leeds | | — | 06.17 | — |
| | Plymouth | | 12.19 | 13.08 | 330 |
| | York | | 19÷10 | 20.13 | 340 |
| | Bristol | F | 00.31 | — | 213 |
| | | | | Total | 1,580 |

## Operational Control

However well the planners do their job, there will inevitably be occasions when the service is disrupted and emergency measures have to be implemented. Major interruptions on BR are comparatively rare, but smaller incidents can often have a disruptive effect on services. Regional control offices located at Crewe, Glasgow, York, Swindon and Waterloo are responsible for day-to-day supervision of traffic flows and the monitoring of resources and crews. If a route is blocked, the Control Office will arrange for trains to be diverted and make plans for rolling stock and crews to be redeployed. In some instances, for example, a blockage of the East Coast main line between Newcastle and Berwick, necessitating a diversion by way of Carlisle and Carstairs, the assistance of another region may be sought.

Regional Control Offices are also responsible for ensuring that all stock is in the correct location for the start of each day's service. As the London Midland Region does not have an allocation of HST sets, control of the fleet is shared between Swindon and York. York control is manned round the clock in three 8hr shifts. Each shift has two HST controllers, one for operations, the other for maintenance. The operational controller knows the whereabouts of every HST set, the diagram it is working and details of every power car and trailer vehicle in the rake. This data is recorded on a card index and includes details such as base depot, the date of the last overhaul, and whether the vehicle has been refurbished or repainted. More detailed information is recorded for the fleet of power cars. The task of the maintenance controller is to monitor the progress of sets and individual trailers and power cars out of service for repairs. He must also ensure that each set receives its 'A' or 'B' examinations at the proper time. The organisation at Swindon is broadly similar.

Solving even minor operational problems requires a high degree of co-ordination and co-operation from a large number of staff. A power car may suffer a small crack in its windscreen or have a defective speedometer and, in the interest of safety, the train cannot be driven from this power car. It may then be possible to turn the train between journeys to avoid its removal from service at a critical time. HSTs can be turned quite easily, using the junction layout, at Plymouth, Swansea, Cardiff, Bristol, West Hampstead, Acton, Newcastle and Edinburgh. If this is done, stations on the train's next journey have to be advised so that passengers will know that the train is running in reverse order.

The hypothetical case of a midday southbound East Coast HST from Aberdeen to King's Cross, which suffers a power car failure approaching Newcastle illustrates how Control handles operational problems. It may be possible to rectify the failure during the station stop at Newcastle, but if not there are three options; terminate the train at Newcastle and transfer the passengers to a later service; bring out a spare set from Heaton Depot; or continue to King's Cross with one power car and lose more time en route. If it is a mid-morning service in the peak of the summer holiday season, detraining 400 or so passengers at Newcastle is probably not an option, as the following service will also be well-loaded and unable to cope with another train load. On balance, the time taken to mobilise a spare set at Heaton depot always assuming one is available, will add more to the journey time than soldiering on to King's Cross with one power car.

This solves the immediate problem, but the failure will have a knock-on effect on other services in the set's diagram. Suppose it is diagrammed to work back to Edinburgh and is due for an 'A' exam at Craigentinny depot.

Based on previous experience the Control Office can calculate the likely delay and expected time of arrival at King's Cross.

Assume that this will now be 17.15, during the build up of the evening peak. During the 3½ hours it takes to get from Newcastle to King's Cross with one power car, Control starts to replan the peak service out of King's Cross by transposing sets, together with train crews and catering staffs, to cover the sequence of busy northbound departures. Before each transposition can be made, the Maintenance Controller at York has to check each set's next 48hr 'A' examination. Can this be deferred, or is the mileage since the previous 'A' exam too high? Again, does a set which has been in service since 06.00 have sufficient fuel to get from King's Cross to Glasgow and back to Edinburgh, instead of the shorter diagrammed journey to Leeds? Can Heaton undertake an additional 'A' examination for a Neville Hill set transferred to a service terminating at Newcastle? What about the 19.30 to Leeds? There is no set to cover this working and the train is almost fully booked. Is the defective set capable of working back to Leeds with one power car? Time will be lost, but is it preferable to cancelling the train completely? Moreover, there is no spare power car at Bounds Green but there is one at Neville Hill which can be exchanged during the night. Regional Control are reasonably pleased with their efforts. Two services were badly delayed, but most services left to time. However, their work is not finished. The four HSTs which have been transposed to other diagrams will have to be transferred back to their original work cycles during the following day.

*Right:*
Cleaning in progress using the specially developed ladder.
*Colin J. Marsden*

*Below:*
In July 1974, the 10.39 Manchester-Plymouth is seen on Hemerdon Bank. *Colin J. Marsden*

*Top:*
Cross Country connection, with the DMU at the right waiting at Gloucester to carry passengers from the arriving 12.00 Newcastle-Cardiff on to Kemble and Swindon. *Michael J. Collins*

*Above:*
The 10.55 Sheffield-St Pancras service accelerates away from its stop at St Albans in December 1982. *Michael J. Collins*

*Left:*
Through uncontrolled lineside vegetation, the 14.10 St Pancras-Sheffield approaches Duffield in July 1986. This gives a clear view of the exhaust deflector mentioned earlier. *Colin J. Marsden*

InterCity 125

KETTERING STATION

*Above far left:*
The 15.00 Sheffield-St Pancras, headed inappropriately by *Tyne & Wear Metropolitan County*, passes Duffield in July 1986.
*Colin J. Marsden*

*Far left:*
Semaphore signals for the 10.05 St Pancras-Nottingham at Kettering in January 1983.
*Michael J. Collins*

*Top:*
A contrast in front ends at St Pancras in December 1985.
*Michael J. Collins*

*Centre left:*
Clay Cross Junction, where the Midland main line diverges, with a St Pancras-Sheffield HST taking the Erewash Valley line. The route via Derby is off to the right.
*Michael J. Collins*

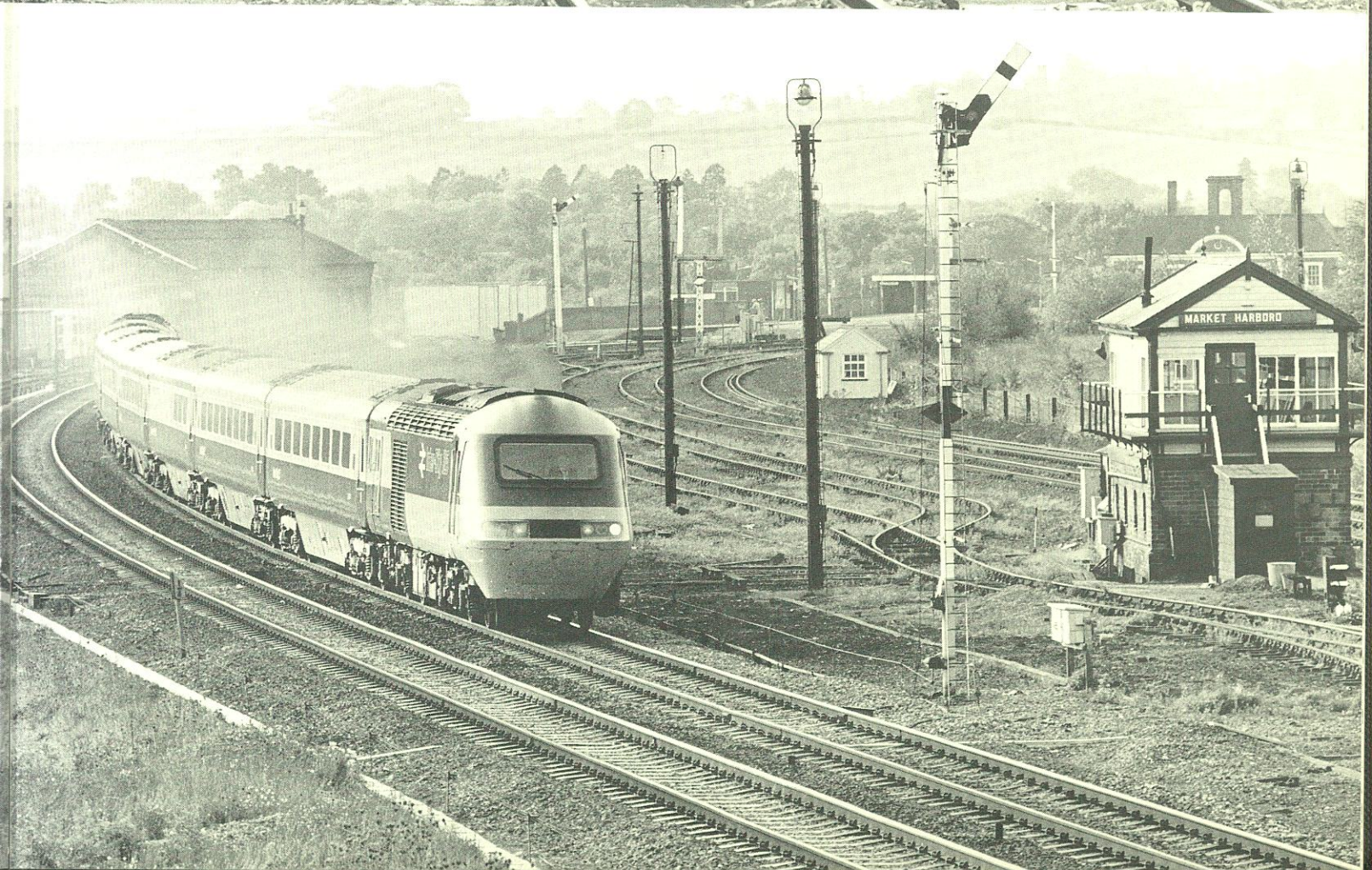
*Left:*
A contrast in centuries, typical of the Midland main line today, with a 20th century HST (07.11 Leeds-St Pancras) framed in the pillars of 19th century Kettering station, in January 1983. *Michael J. Collins*

*Above:*
The 13.30 Sheffield-St Pancras HST just south of Sharnbrook Summit, in February 1983. *Michael J. Collins*

*Below:*
The 14.15 St Pancras-Sheffield passes Ilkeston in June 1983. *Colin J. Marsden*

*Above right:*
The 07.11 Leeds-St Pancras service runs under the wires through Harpenden. Note the large tinted glass sun visors. *Michael J. Collins*

*Below right:*
Shrouded in exhaust fumes, a St Pancras-Sheffield HST accelerates away from Market Harborough in October 1984. *Michael J. Collins*


MARKET HARBORO

*Above:*
With Midland main line and North East-South West services, Derby is well served by HSTs. Here, a St Pancras service winds its way out of the station. *Michael J. Collins*

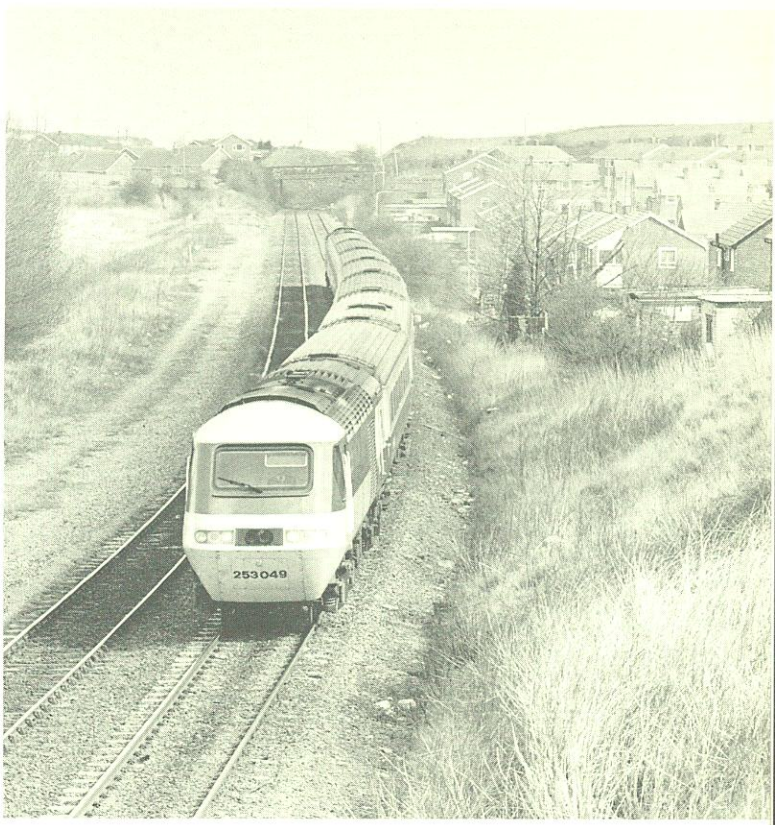
*Below:*
Additional HSTs to serve Hull and Middlesbrough were included in the controversial submission for seven extra sets. This is a Hull-King's Cross train at Stainforth & Hatfield in February 1984. *Michael J. Collins*

*Right:*
Extra use was obtained from East Coast HSTs by using them on commuter services between Peterborough and King's Cross. With extension of outer suburban electric trains to Peterborough, commuters were less than happy to lose their 125mph DMUs. Here the 17.41 HST Peterborough service waits at King's Cross in August 1984. *Michael J. Collins*

*Above:*
Illustrating the long hours worked by HSTs is the 20.04 to Hull, seen here before leaving King's Cross in February 1985.
*Colin J. Marsden*

*Right:*
Creative use of marginal time allowed Great Malvern to enjoy an InterCity 125 service. This is the 10.25 Paddington-Great Malvern, at Oxford, in April 1985. *Michael J. Collins*

Bristol
Temple Meads



*Left:*
the InterCity Sector launched its first HSTs in a new livery, replacing the original blue and grey colour scheme, on the Western Region. Here, Set 253.030 in the new paint scheme leaves Bristol Temple Meads in March 1984 en route for Weston-super-Mare. *Michael J. Collins*

*Top:*
A Cross Country Edinburgh-Plymouth HST approaches Pontefract Monkhill in April 1983. *Michael J. Collins*

*Above:*
The advantages of a double-ended fixed formation train are demonstrated by this HST forming the 13.36 Paignton-Newcastle. It is seen here at Gloucester, in June 1984, where the train reverses, requiring only a walk along the platform by the driver. *Michael J. Collins*

*Above:*
The 12.00 Newcastle-Cardiff HST service enters Derby station in September 1984.
*Michael J. Collins*

*Right:*
Passing through Mexborough station in Yorkshire, the 07.26 from Plymouth is heading for Newcastle, in August 1985.
*Michael J. Collins*

*Bottom right:*
While North East-South West was the main Cross Country axis, the northwest has not been overlooked. This is the 10.39 Manchester-Paignton, leaving Cheltenham station in June 1984. The disused trackbed at the right is the former Great Western Railway line to Stratford-on-Avon. *Michael J. Collins*

*Above far right:*
An unusual formation is provided by this Harrogate-King's Cross HST, seen passing Barford on the ECML in October 1984, with a trailer guard second (TGS) at both ends. *Colin J. Marsden*

*Far right:*
A symmetrical mix of liveries old (trailers) and new (power cars) on this Paddington-Penzance HST, seen approaching Treverin Tunnel in Cornwall, in April 1986.
*Michael J. Collins*

*Left:*
Set 253.017, in the short-lived second generation 'Executive' livery, approaches Taunton with the 09.25 Plymouth-Paddington service on 31 March 1986. Semaphore signals were removed the following weekend.
*Michael J. Collins*

*Below left:*
In deepest Cornwall, the 07.25 Paddington-Penzance winds its way past Par in August 1986.
*Michael J. Collins*

*Right:*
Where else but the 'Principality' would you find exotic palms and Fowey Hoods (antique wooden wagons carrying china clay) flanking an HST set — in this case the 16.26 Penzance-Paddington approaching Lostwithiel in the summer of 1986.
*Michael J. Collins*

*Below right:*
A Cross Country 2+6 HST in an unusual location near Colthrop on the Berks & Hants line in July 1985. The service is the 07.25 Plymouth-Paddington.
*Michael J. Collins*

253 002
Park Cake

CHAPTER SIX

# At The Limits Of Technology

Nothing appeals so much to engineers as solving a problem. Railway engineers, because they are largely concerned with the problems of keeping equipment running rather than its design or manufacture, get considerable job satisfaction from putting right what goes wrong, and it can be a very rewarding process, as a symptom is pursued down to a cause which may not necessarily be the obvious suspect.

In railway engineering, therefore, there is considerable kudos in problem solving. Thus, when railway engineers meet to present and discuss technical papers, it is odds-on that the subject will be what went wrong and how the author's team put it right. While valuable lessons can be passed on in this way, when this over-emphasis on rectifying failure is combined with the British reluctance to celebrate success, railway engineers are in danger of talking themselves and their equipment into disrepute.

This is particularly true of HST which has been the subject of a series of technical papers, all focusing on shortcomings with various aspects of its equipment, while ignoring its undoubted commercial success. Without HST, those in InterCity who criticise the train would not have a job. And yet, as sectorisation increases the rate of change within BR, the lesson of HST, that who dares wins, has yet to be appreciated fully.

Any evaluation of HST's technical record must start with the well-worn BR claim that, unlike the APT, HST was an extension of conventional railway technology. So it was, but it was the technology of the late 1960s. And because BR's engineers were seeking a great leap forward, the number of manufacturers with the necessary technology ready for service within such a short timescale was limited. Thus, the only alternative to the Paxman Valenta diesel engine was either the Deltic two stroke or a gas turbine. Even with the benefit of hindsight, the Valenta was clearly the right choice. It is worth noting that 20 years after the Valenta (or Ventura Mk 3, as it was then known) was selected, re-engining an HST power car involves a weight penalty of nearly 4 tonnes.

Similarly-brave decisions were taken in other areas. BR put its first disc brakes into passenger service with the Class AM10 (now Class 310) electric multiple units in 1966. It was a giant step into the unknown to go from braking a 57 tonne, 75mph suburban train to a 78 tonne 125mph power car within five years. It was only after 10 years of revenue-earning service that studies showed that real-life operation generated thermal loads 30% above the calculated capacity of the power car brake discs.

Brush had demonstrated diesel electric drive based on an alternator, rather than a direct-current generator, with the 4,000hp *Kestrel* prototype. This locomotive also incorporated replaceable electronics control modules. All this technology was transferred to the HST transmission and control system which also incorporated power electronics such as the three-phase phase-angle-controlled thyristor load regulator. The performance of this equipment, not least the elimination of brushgear and its associated maintenance and risk of flashovers with the introduction of the alternator, exceeded expectations. Figures obtained for the Western Region fleets in September 1986 illustrate this. The repair work-load on a locomotive of similar vintage, like the Class 56, can be divided up equally between engine, electrical machines/control equipment and miscellaneous components such as brakes and running gear. In contrast, on the HST electrical machines and control equipment took up only 5% of the total workload.

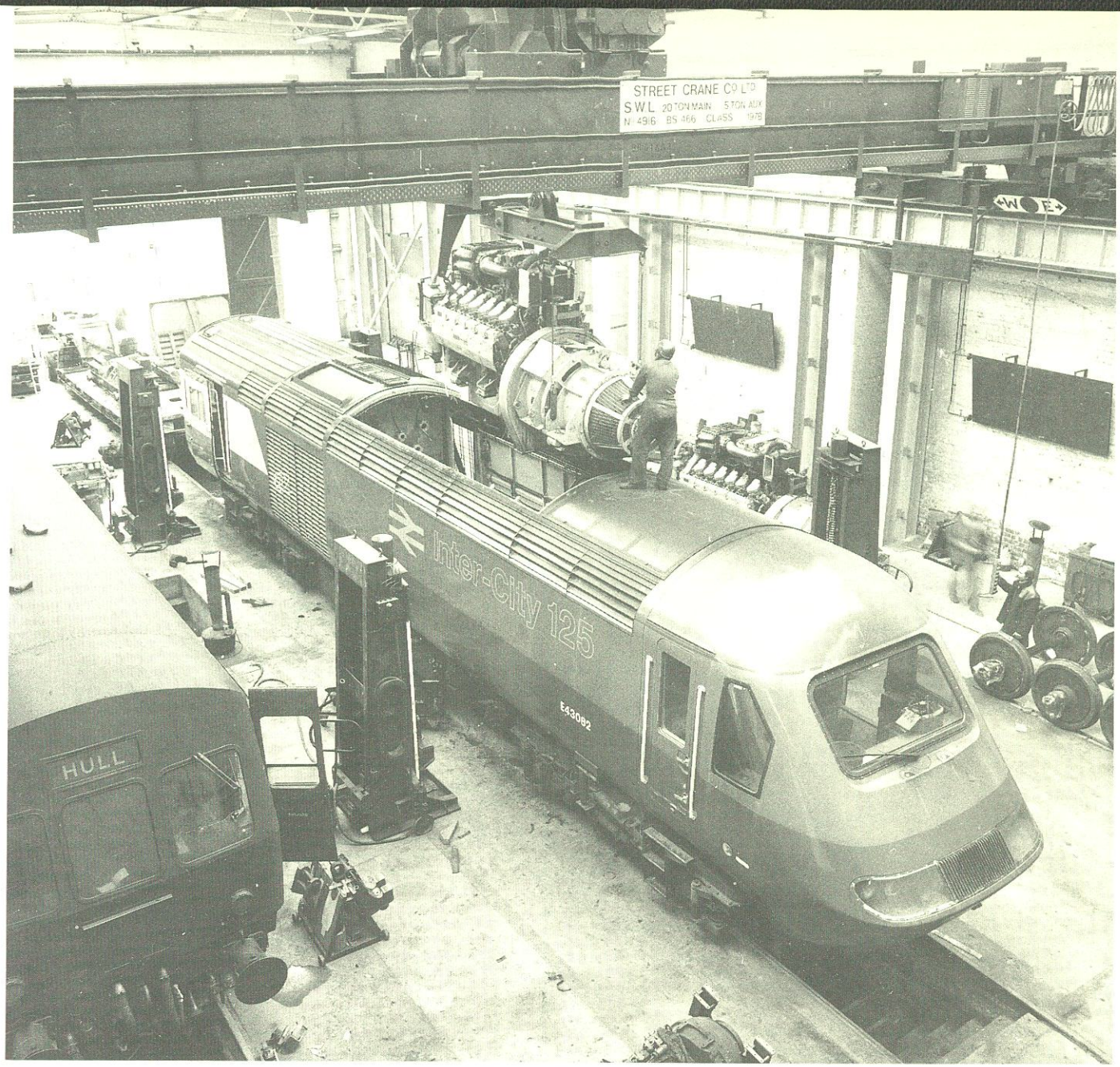
Another significant innovation was the decision to adopt the constant frequency/constant voltage output for the train auxiliaries which gave a dual benefit. As mentioned in an earlier chapter, it eliminated the troublesome motor/alternator set on each coach, with its twin rotating electrical machines including a direct current motor with its maintenance requirements. It also allowed all the auxiliary drives on the power cars to be powered by squirrel cage motors which are far more reliable than dc drives, and maintenance free.

To simplify maintenance of the Mk 3 coaches, auxiliary equipment, such as the air conditioning system and air compressors, were designed as easily-removable modules and were mounted below the vehicle floor where they are protected by the distinctive skirts between the bogies. Service experience has left maintenance engineers in two minds about this concept. While in theory it is an attractive proposition to be able to 'pull' a failed unit and replace it with a tested module, in real life, in the depot, it is not so straightforward.

First, even with the module concept, total replacement is a major operation which is hard to justify when the problem may be a fault which a fitter could rectify in situ relatively quickly. Second, complex equipment, underfloor-mounted and designed for modular repair by replacement, is unlikely to be accessible for in situ repairs. Third, depots cannot hold unlimited stocks of replacement modules and Murphy's laws ensure that if a depot has one spare air-conditioned module in its stores, two coaches will fail on air-conditioning units that night. Finally, as HST utilisation improved over the years, time on depot diminished, making a quick fix to keep the train running until the next 'B' examination preferable to a module change.

Another aspiration which took some time to achieve was the concept of HST as a fixed formation. Before service started, BR engineers believed that the power cars and coaches of each HST set would stay together between visits to British Rail Engineering Ltd at Derby for annual overhaul. This dream lasted only until HST entered service. Such is the pressure on HST resources that the service would soon fall apart if a failed vehicle meant that a complete set had to be set aside for repair. Thus, from day one, depot engineers began shunting vehicles in and out of sets to keep the service running. Indeed, one of the first Western Region initiatives was to convert a Class 08 shunter with buck-eye couplings for moving the similarly-equipped Mk 3 coaches. Over the years, as reliability of coaching stock improved, it has become possible for sets to stay together, but power cars often continue to play musical chairs overnight.

Fixed formation operation also complicates the established measure of availability and reliability. Traditionally, these key statistics had been of concern only to the traction engineers, because, with conventional locomotive-hauled working, spare passenger vehicles could always be produced from somewhere,




*Above:*
Changing the engine of a HST power car at Neville Hill depot, Leeds. Under BR's cost effective maintenance programme, Level 5 'super depots' will be responsible for much more of this repair by replacement. *Philip Ashwin Photography*

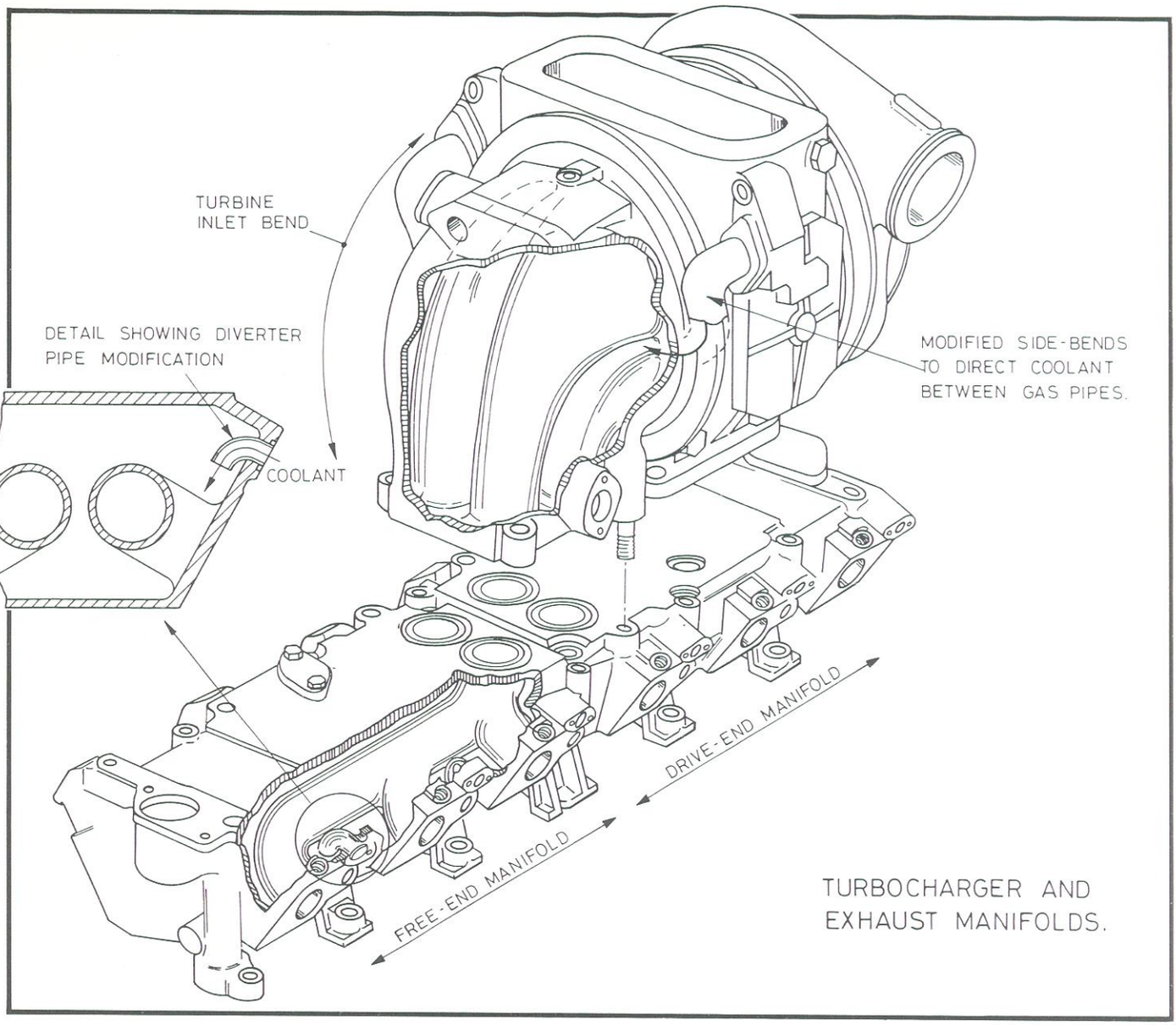
even it it meant running a mix of old and new stock in the same train.

With HST, this facility disappeared. Each region had its fleet of HST power cars and coaches. If a coach went down, it was no longer a case of bringing a replacement from the siding, not even if another Mk 3 coach was available, because of the incompatibility between the locomotive-hauled and HST power systems.

Thus availability applied to the complete train, which meant that it could be affected by failed passenger vehicles. Initially, British Rail's Chief Mechanical & Electrical Engineer promised an availability of 78%. Fleet service soon began to expose problems which the prototype testing had not been able to reveal. By 1978, for example, the Western Region was diagramming on the basis of 20 sets available from 27 (74%). As the obvious 'bugs' were removed, and BR depot engineers learned the new equipment's foibles, availability has steadily increased.

After a decade of operation, the fleet was being diagrammed on the basis of an availability of 78.18%. However, following French Railways' practice with the Train à Grande Vitesse (TGV), during the weekend peak (starting on Friday) the availability increases to 80.5%. Partly, this is possible because maintenance periodicities of critical components are well-enough understood for longer exams to be extended for a few days if they fall due over the peak weekend period. Having mentioned TGV, it is worth comparing the regime within which the French Railways operate its high speed fleet with that of HST.

For a start, night-shift working is considered anti-social in France, and most servicing and maintenance takes place during the day. For this to be possible, spare sets have to be provided and, during the week, the TGV fleet is diagrammed for 60% availability. At weekends, this rises to 90% plus. It is instructive to remember that British Rail has to justify its traction and rolling stock purchases to a sceptical Department of Transport; an HST fleet with a weekday availability under 70% would certainly not produce the necessary financial return.




HST reliability figures also have to be considered in a slightly different light from those of locomotive-hauled trains. British Rail's definition of a passenger train casualty is one which results in a delay of five minutes or more. With the exception of 'lows' during crisis periods, such as the engine-overheating problems in 1983, HST power car reliability has stabilised around 24,000 miles per casualty. This compares with about 12,000 miles per casualty for passenger locomotives such as Class 47 and Class 50. With two power cars per train, overall miles per casualty for an HST set is thus 12,000.

However, with a balancing speed on the flat on one power car of around 110mph, an HST with one power unit shut down completely can still make reasonable time. This is illustrated by the fact that if the definition of a casualty is extended to 10 minutes late (the same as BR freight train statistics), 30% of HST casualties disappear. The individual power car figure then becomes 34,330 miles per casualty. To put this figure in perspective, the privately-owned Class 59 freight locomotives in their first year of operation average 15,000 miles per casualty.

It also has to be remembered that for the all-important passenger, what counts is the reliability of the train. The journey described in *Chapter 3* was a technical casualty on both the outward and return legs. But where a locomotive-hauled train with a faulty power unit might not have completed the journey at all, HST, with its built-in redundancy, gets you there.

Having established the background to HST operation, it is time to review the technical development of the train.

Problems can be grouped into four categories. These can be summarised as:

Inherent design faults which would have been revealed by intensive prototype testing

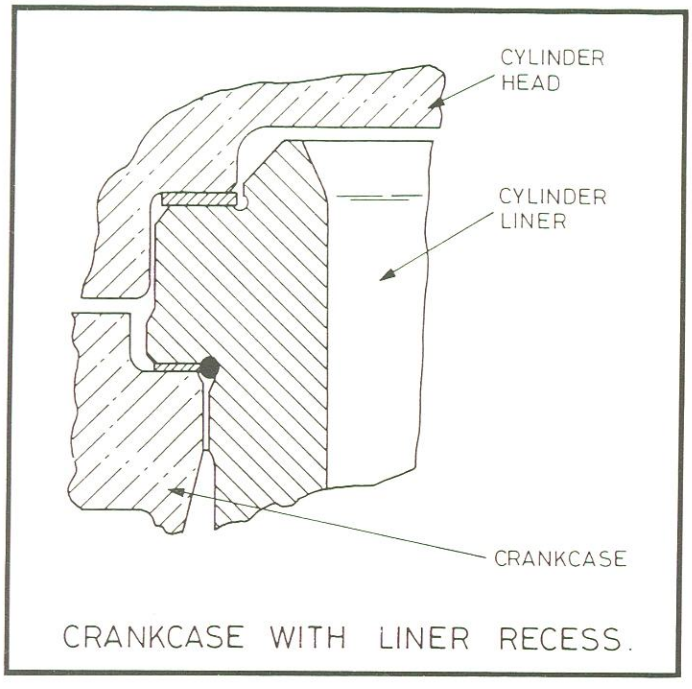
Changes for the worse from the original design

Service conditions which took equipment outside its foreseen operating environment

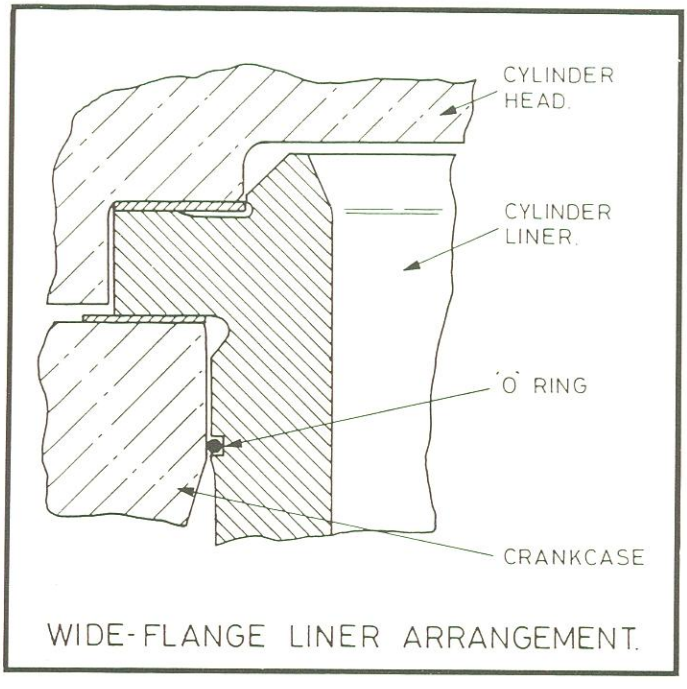
Self-inflicted wounds.

A typical inherent design fault showed up as the appearance of cracks in the swinging arm of the BT10 bogie primary suspension outboard of the axlebox. This was detected on a locomotive-hauled Mk 3 vehicle and checks on the entire Mk 3 fleet resulted in a number of vehicles being taken out of service. This was a simple case of fatigue fracture due to inadequate design, at a time when computer analysis was in its infancy. A revised axlebox was designed on the basis of static and dynamic strain-gauging of existing swinging arms and the entire fleet

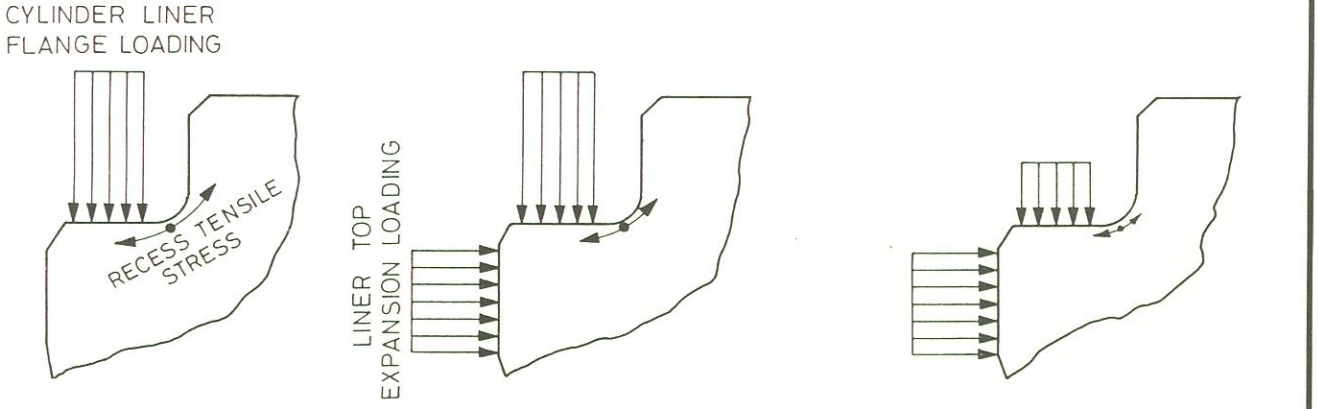
*Right:*
Oil stains on bodysides plus fitted towbar on power car No 43162 indicates major internal mechanical derangement. It is parked at Bounds Green in February 1987 awaiting a move to Neville Hill depot for engine change. *Colin J. Marsden*




CRANKCASE WITH LINER RECESS.




WIDE-FLANGE LINER ARRANGEMENT.




1. AT REST, COLD.

2. AT FULL POWER.

3. AT FULL POWER WITH MAXIMUM CYLINDER PRESSURE.

LINER RECESS LOAD CYCLING.

retrofitted. Analysis of the new design predicted an indefinite life.

A minor, but amusing, design fault was found in the control system. The main alternator exciter-field contactor is interlocked with the traction motor and reverser circuits. In the early days, the spindle operating this interlock was prone to sticking, which could prevent the traction motor contactors from opening. This, in turn, held the reverser contactors in a fixed direction.

When a driver changed ends at a terminal station with an interlock stuck, it meant that the alternator on the power car with the fault could not excite. As a result, the train would accelerate away on one power car. But, as the speed built up, the traction motors in the faulty power car would start to generate, producing an electric braking effect. This built up and, at around 5mph, the tractive effort from the working power car equalled the braking effort from the other. The solution was a low friction bearing for the spindle plus a spring to ensure that the interlock opened.

The engine provided a classic example of a change for the worse. The first batch of production engines were supplied with turbocharger turbine inlet nozzles with 32 vanes — as on the prototype engines. Then, the foundry which produced the nozzle rings for Napier turbochargers closed down. At short notice it proved impossible to find another foundry able to produce the 32-vane nozzle ring, and a 24-vane unit had to be substituted.

These proved subject to thermal fatigue cracking between the ring and the nozzle blades. The solution was to change the design slightly, with a smoother curve at the point where cracking initiated, combined with a change in material to an alloy with a higher strength. Longer term, a firm was found which could produce the original 32-vane nozzle ring in the new alloy.

A long-running problem area has been the traction motor gearbox. To reduce the unsprung mass to the level required by the Civil Engineers for 125mph operation, the traction motors are mounted on the bogie and drive the axles through a flexible drive and gearbox. The flexible drive is needed to allow the axle to move up and down on its primary suspension relative to the fixed motor. Although the gearboxes on the HSDT performed well, it was decided to modify the design for the production trains to improve lubrication of the gearbox bearings and give a longer period between servicing. The pressed steel gear-case was replaced with a cast light alloy unit which increased the oil capacity from four to six pints. In addition, interior weirs were added to channel oil to the bearings rather than having to rely on oil splash.

Despite these modifications, and the use of a multigrade oil, service experience showed that the gears themselves were suffering from inadequate lubrication. Oil also leaked past the seals and, as the oil level fell, gearboxes could seize. In several cases power cars had flats worn on wheels as a result of a seized axle being dragged along the track undetected. The root cause of the problem was the seal where the axle passed through the gearbox. Air was able to pass this seal and pressurise the gearbox, forcing the oil mist inside the gearbox out through the pinion bearing.

A new design of seal was introduced in 1980, and the filler was moved allowing the oil capacity to be trebled. A sight glass was also installed so that the oil level could be checked quickly. Leakage continues to be a problem and a traction motor gearbox oil-level check is part of the 'A' exam carried out every two to three days. Indicating the attention to detail which has become a part of everyday HST operation is the daily oil-level check on power cars with a known leak. Fortunately, the new design of seal can be changed during routine servicing or at an 'A' exam.

A serious derailment at Darlington, caused by a wheel-set with a seized gearbox being dragged through a crossing, resulted in a modification to the wheelslide protection (WSP) equipment of the braking system. This was rearranged so that a seized gearbox would result in the wheelslip warning light being illuminated whether the train was under power or coasting. Normally, of course, the light would come on only if the wheels slipped with the power on under acceleration.

*Below:*
Continuous development has extended periods between works overhauls to two years. This is power car No 43055 at BREL Derby Works in September 1985. *Colin J. Marsden*

Drivers were then instructed that, in the event of prolonged wheelslip indication (normally, the light flickers on and off as the slip is corrected automatically) they must stop the train and check that the power car wheels were turning. After that, the train was to be taken at slow speed to the next station where the passengers would be transferred to another train.

Unfortunately, the WSP equipment itself was unreliable and prone to spurious operation caused by interference from other electrical equipment. In a six-month period during 1980, no fewer than 25 East Coast HST services were cancelled because of spurious seizure indications caused by WSP system failures. So it was back to the drawing board and the current scheme implemented, where the wheelslip detection system is responsible for detecting seizure under power with the WSP taking over when coasting.

As already explained, the HST brakes at 9%g compared with 7% for conventional rolling stock. At such relatively-high braking rates there is naturally a tendency for the wheels to lock up if they encounter a section of track with low adhesion. While the HST braking rate requires an adhesion level of only 9% compared with the 40% plus obtainable on dry rail, adhesion can fall to very low levels through the effects of rain, atmospheric pollution and oil dropped by trains on the railhead. Adhesion also falls off with increasing speed, hence the dual-rate braking on HST, with full-rate braking coming in only below 90mph.

The WSP equipment on HST vehicles measures the speed of each axle through probes in the axleboxes. The speeds of all four axles on each vehicle are monitored and processed in two ways. Differentiation gives the deceleration of each axle. If the deceleration of an axle exceeds a certain level (25%g) it means that the brake force exceeds the available adhesion by such an amount that the wheels will slide. The WSP system then de-energises the brake on the affected wheel-set. The system also compares the speeds and deceleration of all the axles on the vehicle. If one axle is slower than the rest by 5mph plus 2% of train speed, or if its deceleration is higher, it is considered to be about to slip, and its brake is released. The time taken to detect slip and initiate correction is around .025sec.

Having detected incipient slip, the system continues to monitor the axle speeds and, under normal conditions, as soon as the difference in speed disappears, the brake on the offending axle is reapplied. Obviously, the system has to be self monitoring, because if a number of WSP systems on a train failed to 'off', the brake force could be reduced to a potentially dangerous degree. To prevent this happening, the system is programmed so that if the speed difference indication lasts longer than 4sec, the brake force is reapplied anyway.

With the original production trains, the WSP device also locked itself out after the same 4sec period. It could then be reactivated only by depot staff resetting the locking-out device. In practice, this meant that a spurious reading could lead to a functioning WSP unit being shut down. For example, the WSP system on the power car did not know which way the train was going and could thus think that wheelspin under power was uncorrected wheelslip, and shut down. The result was a rise in unnecessary wheel-flatting. The solution was to replace the lock-out device with a latched indicator, which tripped if the 4sec limit was exceeded, to alert depot staff to a potential fault.

Despite a number of different designs of WSP equipment, wheel-flatting remained a major problem into the early 1980s. Once again, the sheer unpleasantness of the traction environment was an important factor. For example, the trailer car speed probes are mounted on the axle-end and receive all the vibration and shock from the wheel on rail. On top of that, the axle heats and cools each time the wheel-cheek mounted discs are applied. Standard wiring subjected to this severe environment fractured. By 1986, the wheelslip system seemed to have been solved. Unusually, it is a problem which the trackside observer can monitor, simply by listening to a passing HST, the presence of a 'flat' producing a distinctive high-frequency rattle as the offending bogie passes.

Undoubtedly, HST took braking to the limits of technology, not just in the brakes themselves but in that area — about the size of a 1p piece — where steel wheel meets steel rail. In addition to flatting, trailer car wheels also suffered from breaking up of the tread which caused rough riding. This was traced to the formation of a very hard and brittle form of steel, called Martensite, in the surface of the wheel. To form Martensite, an area of the wheeltread would have had to be heated and cooled through 600°C.

This heating effect is caused by friction between the wheel and rail during braking. Significantly, the power car wheels, which have tread brakes, to 'scrub' or condition the wheel tread as a way of improving adhesion, are nowhere near so badly affected by this problem. This is probably because the tread brake keeps the surface of the wheel at a more uniform temperature during braking.

It takes just over 70sec for an HST to come to a halt from 125mph. Behind this simple statement are some very large numbers indeed, as far as the disc brakes are concerned. When braking starts, an 8-coach + 2 power car HST has about 468 million foot pounds of kinetic energy, accumulated as the result of two, 2,250hp diesel engines at full power accelerating the train for a distance of around 11 miles.

Conservation of energy means that the speed energy of the train has to be converted into some other form, and most of that other form is heat, generated in the disc brakes. Averaged over the 80 disc brakes on the train, this gives 5.85 million ft lb to be dissipated by each disc which has an area of 1,300in$^2$. During the 70sec of braking, each disc is generating heat at the rate of 81,250ft lb/sec. This is equivalent to 147hp, which may not sound much until it is converted into the equivalent electrical energy which is 110kW. With each disc generating the heat output of 110 one-bar electric fires, it is not surprising that disc temperatures can rise to 750°F.

These are average figures; because of the higher axle load, the power car discs do proportionally more work, and this is where the engineers have had to overcome the severest problems. The brake pads act on cast iron discs bolted on each side of the wheel-webs. It is the bolting arrangements which were at the heart of much of the brake problems. As the disc heats up under braking, the material expands. Thus the bolts have to accommodate the expansion of the disc while locating it on the wheel-web. To meet this requirement, two of the bolts are 'fitted', that is, a tight fit in the holes through the wheel-web, while the remainder are a loose, or 'clearance fit'.

Originally, the fitted bolts fractured under the repeated stresses. To cure this, the diameter was increased and the clearance bolts tightened to a higher torque to reduce the load on the fitted bolts. The clearance bolts then began to fail. Fatigue failures usually need a discontinuity in the shape of the component for initiation. This can be a sharp, rather than rounded, corner or change of cross-section. In the case of the clearance bolts, it was the threaded portion where the bolt screwed into one disc. The solution was simple — instead of screwing the bolt into a threaded hole in one disc, the hole was drilled out and the bolt secured by a nut.

While this problem existed, one of the more exciting moments of depot life was the removal of broken bolts. Fracture left the thread of a 1in diameter steel bolt screwed into the disc. The accepted way of handling such a situation is to drill out the offending threaded stub and then retap the thread on the hole in the disc. This could take up to four hours, which is a lifetime for an HST depot night-shift.

Another time-consuming problem already encountered was the removal of fitted bolts which had seized in the hole through the wheel-web. Instead of driving these bolts out with a hammer, a depot engineer seized on the idea of using a cartridge gun of the type used for driving nails into concrete floors. The piston of the gun was held close to the offending bolt and 'bang', the bolt was out. The same technique shortened the broken bolt removal time to 20min.

Having sorted the bolts, the problem remained of the discs themselves fracturing at the fitted bolt positions. As the problem was one of thermal stress, two potential solutions were available. Either get rid of the heat faster, by improving the thermal conductivity of the metal, or make the disc material more stress-resistant. In the event, neither approach was successful, and cracking continued.

Maintenance of services required BR to live with this problem and, as a result, discs are monitored for cracks which are not allowed to exceed 6in long on power cars and 5in long on trailer cars. If a replacement wheel-set is not available when the limit is reached, depots are allowed to isolate the brakes on that wheel-set and return the train to traffic. Only one wheel-set may be isolated per train and HST Maintenance Control keeps track of all HST sets with an isolated wheel-set. With one pair of brakes out of action in this way, the train can still meet the braking curve requirements.

With the power car disc cracking problem seemingly intractable, BR decided to try an alternative type of disc brake. This is the self-ventilated type where the discs have radial fins on the inner surface in contact with the wheel-web. These fins hold the disc away from the wheel and form passages between the centre and outer rim of the disc. As the wheel rotates, centrifugal force throws the air in the passages outwards, drawing fresh air in through the centre of the disc. During braking, this flow of cooling air helps dissipate heat from the disc. A further benefit is that the fins effectively increase the area of disc available to dissipate heat. The ventilated disc selected was the BSI design, produced under licence in Britain by Davis & Metcalfe. Another feature of the BSI-Metcalfe units is a resilient type of mounting which allows the disc to move relative to the wheel-web during braking, to accommodate thermal expansion and contraction without inducing high levels of stress. Following successful service experience with a trial installation, BR has ordered 50 vehicle sets of BSI-Metcalfe ventilated discs for retrospective fitting to HST power cars.

A number of shots in the foot will emerge in the history of HST engine problems which follow, but mention must be made of the GEC traction motor saga. British Rail has a morbid fear of being ripped-off by monopoly suppliers. It feels happier if it can buy the same equipment from two firms — otherwise known as dual-sourcing. Thus, with the Brush traction motors performing well, it invited GEC to bid for the third batch of trains ordered, the 14 sets for London-West of England services.

GEC was successful, which was unfortunate for all concerned. The company was moving traction motor production from one plant to another which compounded communications problems between the design and manufacturing functions within the organisation. As a result, the manufacturing process produced stresses within the commutators of the GEC Type 417 HST traction motors which were outside the range envisaged by the motor's designers. Thus, when the motors entered service, the commutator bars could distort, and commutation and brush life deteriorated sharply.

These trains entered service when the commercial impact of HST on Western Region fortunes was at its height. But the traction motor problems meant that the trains, already being delivered late, had to be withdrawn because, if one power car failed, the remaining unit could not handle the steep Devon banks on its own. Because the problem showed up only in service, it took a long time to track down. BR's engineers were furious, and despite pressure from their commercial officers to release the trains for service, refused to do so until modified Type 417 motors passed BR's tests — which despite successive modifications through the summer of 1980, they failed to do. Even worse, GEC had won a further contract to supply motors for the 18 HST sets for North East-South West services. This

contract was cancelled, which meant delayed delivery while Brush geared up to produce more traction motors. These 18 sets included a further four for the Eastern Region to handle Hull/Middlesbrough services which had to be put back. Complicating GEC's search for what was wrong with the Type 417 was a deterioration in the grade of brush specified for the motor. Eventually, it was discovered that control of the manufacturing process was at the heart of the problem. New equipment and inspection processes were installed and the Type 417 was redeemed.

However, coming on top of similar problems with GEC traction motors in the Class 313 EMUs, the Eastern Region, in particular, was less than pleased with its supplier; and Paxman, the manufacturer of the Valenta, was also a GEC subsidiary.

From the beginning, the Valenta had suffered from a number of problems, some the result of design, others because of incorrect manufacturing processes, but nothing so severe as to affect services. Localised cracking of the original crankcases — fabricated from steel plate and castings — had resulted in a switch to cast-iron crank-cases. But, in general, continuing problems were being contained while permanent solutions were found.

Then, in 1983, while Britain enjoyed the hottest summer for many years, the HST service disintegrated, and the cause of its collapse was an epidemic of overheating Valenta diesel engines. A diesel engine is simply a device for converting the energy in fuel into power. Even though the diesel is the most efficient prime mover, an engine like the Valenta converts only about 40% of the energy in the fuel into work. Of the rest, some goes out through the exhaust, and the rest is converted into heat inside the engine and has to be disposed of. This is achieved by circulating water around the engine and then through radiators where the heat is dissipated. In the case of an HST power car, the radiators have to get rid of about 1,000kW (the equivalent of 1,250hp).

Two factors are critical for efficient cooling; sufficient coolant has to flow through the engine and it must not exceed a maximum temperature. As a protection against overheating, the temperature of the water leaving the Valenta is monitored. The maximum coolant outlet temperature is 85°F and a high water temperature (HWT) switch shuts down the engine if the temperature reaches 95°C. Another protection system shuts down the engine if the coolant level in the 14 gallon header tank falls to a level where the engine could suffer.

In 1983, Valentas shut down from overheating, and cracks inside the engine allowed water to leak away, making the overheating worse and shutting engines down on the low water level system. The natural assumption was that something had suddenly gone wrong with the engines and the cracking had certainly worsened. Coming on top of the Type 417 traction motor problems it prompted BR into subsequent litigation with GEC, which resulted in a £7 million settlement covering loss of earnings by the HST fleet and favourable prices on future Valenta spares. That the figure of £7 million emerged at all was a breach of the agreement, under which neither side was supposed to disclose the details.

Paxman's immediate assumption was that the failures were entirely the fault of their engine. But as the heatwave ended, and a major joint Paxman/BR investigation of the Valenta's problems was underway, it started to emerge that it was not all the engine's fault. Indeed, the real villain of the piece was the cooler group which was not keeping the engine coolant at the correct temperature. This also had the effect of exacerbating cracking problems.

Gradually, the pieces of the technical jigsaw came together. During the summer of 1983, BR engineers at Paddington had noted that over half the HST power cars coming into the station had HWT trip flags showing that the engine had overheated. On many other engines, the HWT trip did not work at all, leaving the engine unprotected. The system which controlled the radiator fan also malfunctioned. All in all, the Valenta was being maltreated.

It was BR engineers who discovered the cause of the problem. Basically, the radiator panels were being blocked both internally and externally. Internally, jointing compound used during engine assembly was being dissolved in the hot coolant and then precipitated out as the fluid cooled in the tubes of the radiator. Subsequently, the use of this silicon type jointing compound was discontinued and blocked panels were returned to the manufacturer for overhaul.

Large volumes of air pass through the radiators, carrying dirt, seeds, ballast dust and other fine contaminants which adhere to the fins on the tubes. Oil mist from the fan drive turns this into a sticky mess which reduces the efficiency of the radiator to a critical degree. Cleaning this mess off the fins causes even more problems. At first, BR used a high pressure hot-water spray; this bent the fins, reducing the radiator efficiency still further. Other non-damaging methods took too long. Today, a detergent is used which is washed off with a gentler water spray and the watery residue is sucked up from the bottom of the cooler group with a vacuum cleaner.

Overheating exposed weak points in the Valenta's water-cooled cast-aluminium exhaust manifolds. In parallel with the work on improving the coolant group performance, Paxman modified the water flow inside the manifolds to direct coolant to critical, undercooled, areas. The performance of one component in the manifold, the turbine inlet bend, through which the exhaust gases flow from the true manifold into the turbocharger,

*Top left:*
A smoky start for power car No 43157 at Darlington in April 1984 is probably the result of prolonged idling during a station stop. The train is the 06.00 Aberdeen-King's Cross.
*Michael J. Collins*

*Left:*
Coaches at BREL Litchurch Lane Works, Derby during overhaul.
*Colin J. Marsden*

shows how effective the dual approach was. In 1983, turbine inlet bend cracking peaked at 24 a month. Throughout 1985, only two of the new design failed and the cracks were not deep enough to leak.

One power car in particular showed the crucial importance of adequate cooling. No 43194 had seven exhaust manifolds and four turbine inlet bends fail in five months, with the cooler group apparently functioning normally. Then BR engineers discovered that the hoses between the radiator and the engine were collapsing inward as they deteriorated with age, blocking the coolant flow. Mention has already been made of cracking in a number of parts of the Valenta. With the cooling problems sorted out, work continued on reducing cracks both in the exhaust system and the crankcase. With the crankcase, the main problem was where the cylinder liners fitted into the top deck. When the first engines were delivered they were found to be overweight and this was remedied by machining metal off the top deck. This reduction in thickness reduced the resistance to thermal stressing with resulting distortion and leakage around the liner top joint. The thicker top of the cast crankcases reduced this tendency and cracking should have been eliminated by a new flat-top deck which eliminates the recess where cracking and leakage initiated.

However, what caused the problems in this area highlighted a unique, and uniquely-destructive, aspect of HST operation. Every time a Valenta goes on full power, it heats up and its components expand. In most applications, such as power generation and marine propulsion, the engine stays on full power for some time before it returns to idling, the engine cools down and the components contract. Each expansion and contraction stresses the components and fatigue cracking is due to the accumulation of these cycles.

To find out what was happening to the Valenta, Paxman instrumented five power cars and recorded the changes in controller positions during a journey. They found that, on average, the engine went from idling to full power and back to idling every 6min. Two minutes of this time were spent on full power. One Western Region run showed 23 full-power cycles in an hour. Not only that, as the run in *Chapter 3* reveals, the five-position controller has to be used as an on/off switch — either on full power or idling — if time is to be kept. Thus, on average, each HST accumulates 10 thermal cycles an hour, 15 hours a day, 52 weeks a year. No other diesel locomotive engine in the world cycles at this rate, nor was this anticipated when the Valenta was designed and tested for 2,000hr back in the 1960s. Thus a simple feature such as the liner flange seal, which is adequate in other applications, is subjected to movement 50,000 times a year, something for which it was not, and could not, have been designed.

It was this repeated thermal stressing which caused the cracking in the exhaust system. When it was at its height, Paxman began the development of a cast-iron manifold which gave twice the strength of aluminium. However, it was agreed with BR that the change was not necessary because the failure rate with the improved aluminium components had stabilised at a very low level. Exhaust manifolds were failing at the rate of two per month.

Then in October 1986 the roof fell in again and failures started to increase. By February 1986 the failure rate was greater than the earlier replacement rate, proving that it was not simply a batch of exhaust systems reaching the end of their fatigue life simultaneously. By June, manifolds cast in late 1985/early 1986 were also failing; in 1983, fitting new manifolds had at least brought a respite.

Paxman could not understand it. But as replacement with aluminium components was not working, the manifolds in spheroidal graphite (SG) cast iron were ordered into production. Tests of failed manifolds showed no change in quality between 1983 and 1986. Then it was discovered that the onset of the new troubles coincided with the introduction by BR of a new antifreeze. This included a chemical designed to protect the internal structure of the engine by deliberately corroding the surface of the metal, the resulting layer of corrosion acting as a barrier to further attack.

Tests at the GEC laboratories showed that the antifreeze attacked elements within the alloy from which the manifolds were cast, leaving areas where cracking could start.

Subsequently, fatigue tests showed that the new antifreeze reduced the fatigue life of the LM27 alloy used in the exhaust component by three times. Reversion to the original antifreeze reduced failures to less than a half the crisis rate, with a falling trend, but the lesson has been learned and cast-iron manifolds are being fitted progressively.

Meanwhile, following the 1983 experience, BR renewed its consideration of re-engining HST power cars. Mirrlees had developed a new engine, the 12MB190, which would fit in a HST power car and give 2,400hp at 1,500rev/min. Weight is 3.8 tonnes more than the existing HST engine, but the agreement of the BR Civil Engineers to an effective 1 tonne on the axle load was given. Four power cars have been re-engined at BR expense, with a fifth engine supplied by the manufacturer. As part of the development programme, a type test was run equivalent to two years operation, and the engines are now being evaluated in service.

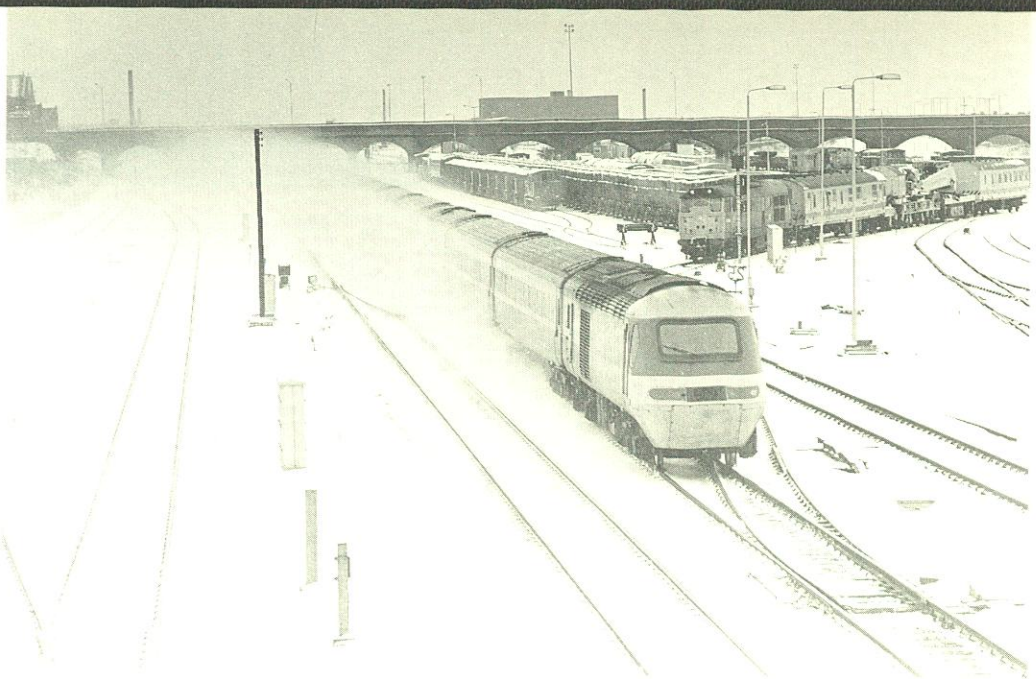
Having read this chapter, it is important to remember what all the engineers' work has achieved. The mileage between overhauls has been more than doubled — from 220,000 to 450,000. This means that a HST returns to Derby for a works overhaul every other year compared with an annual visit when the trains first entered service. By 1987, the cost of annual maintenance had been halved to £495,000.

Similar improvements have been achieved with the much, and often unfairly, maligned Valenta. The original specification called for a top overhaul every 6,000 hours and a major overhaul at 12,000 hours. Today, the target is an intermediate exam at 12,000 hours and a major overhaul, depending on engine condition, at up to 24,000 hours. Work is under way on replacing this schedule with a single overhaul every 20,000 hours.

However, with InterCity shorn of its Government subsidy from 1988, and facing a £102 million turnround by the end of the 1989/90 financial year, pressure on cost-reduction intensified further. British Rail responded in May 1988 by inviting tenders for a HST re-engining programme. Manufacturers were asked to assume a base requirement for a total of 60 power car conversions, to be delivered at the rate of 20 per year starting in April 1989. A possible maximum of 147 was also quoted.

Four firms were invited to bid, Mirrlees Blackstone (Stamford) and Paxman of Britain, Pielstick of France and MTU of Germany. They were asked to quote for a package, under which complete power cars would be handed over to the chosen contractor and returned to BR with their engine transplants tested on a static load-bank and ready for service.

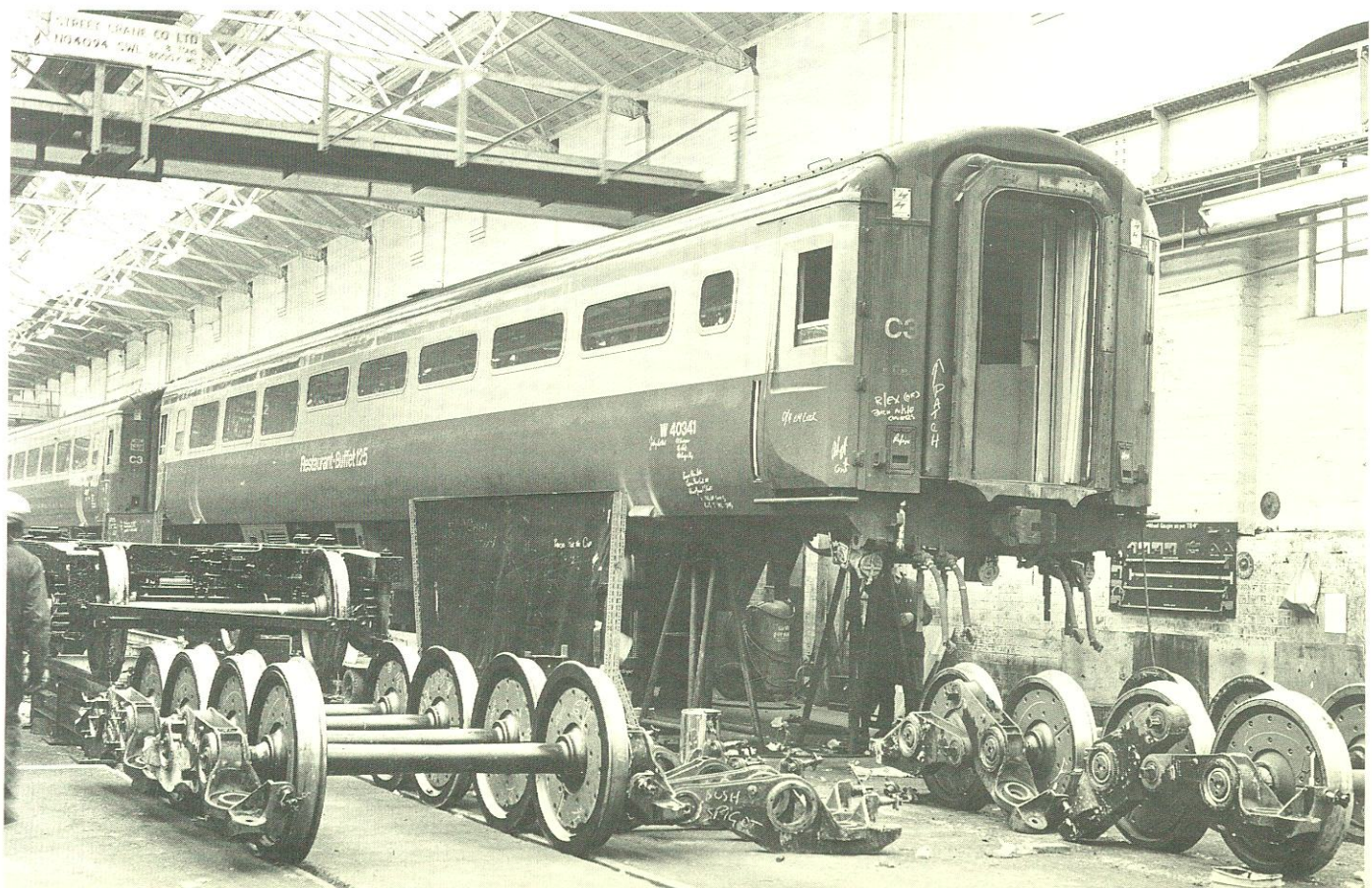
Operating parameters remained the same: 2,250 installed hp per power car and an operating speed of 125mph. Manufacturers were encouraged to retain existing key components such as the cooler group and various protection devices such as the HWT switch.



*Above left:*
While vulnerable to inadequate cooling in hot weather, HSTs have coped well with extremely cold conditions. Here, snow flurries delineate the airflow round the streamlined nose as an Edinburgh-King's Cross express approaches Peterborough at speed, in February 1985. *Michael J. Collins*

*Left:*
Without the visual distraction of livery, the functional lines of the power car front end can be appreciated. Less than forecast aerodynamic drag enabled eight-car formations to be introduced with no loss of performance when plans to uprate engines to 2,500hp were abandoned.
*Colin J. Marsden*

*Below:*
This photograph taken in Litchurch Lane Works, Derby, shows wheel-sets with the swinging arm primary suspension units which are mentioned in the text. *Colin J. Marsden*



CHAPTER SEVEN

# Chasing A Changing Market

The real achievement of the HST programme has been the creation of a 'universal train' capable of fulfilling many different and varied service requirements. As the following route survey shows, each service has its own characteristics depending on the distribution of population, markets and other social factors. One factor is common however: the IC125 is universally popular.

## Great Western Sub-Sector

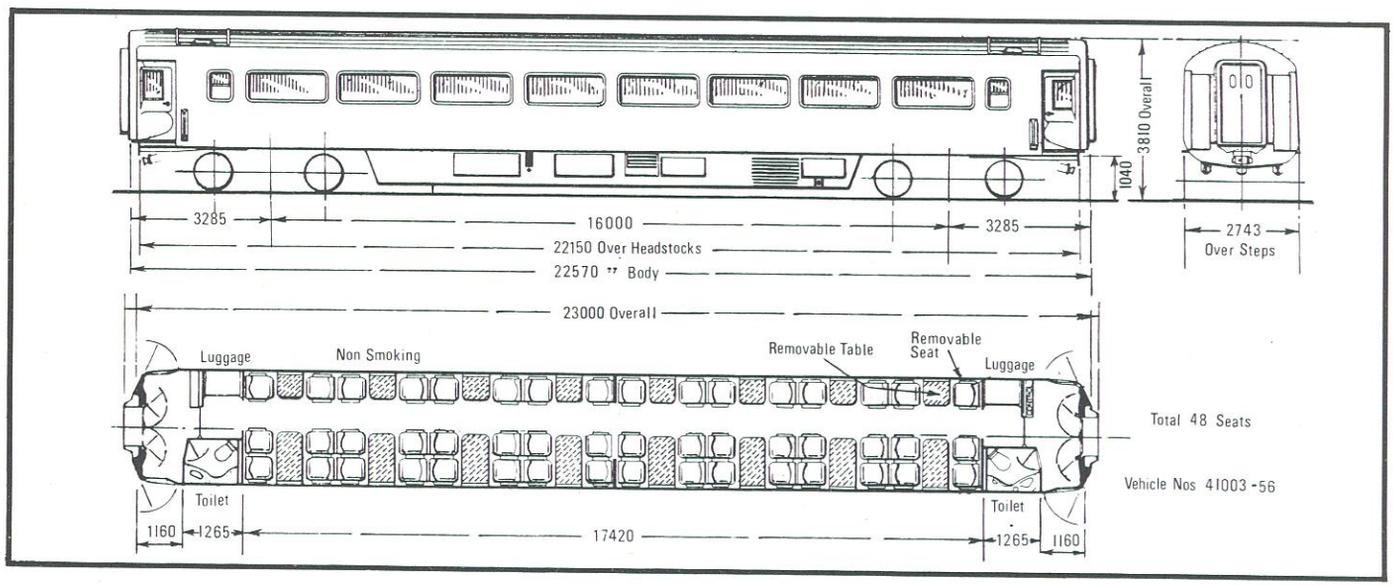
The group of services between Paddington and Bristol, the Cotswolds, South Wales and the West of England — the Great Western Sub-Sector — is now almost exclusively an IC125 operation. The basic service is London-Bristol/South Wales, with a good mix of business travellers, commuters and leisure users. An interesting social phenomenon on the Bristol route is the growth of towns like Didcot, Swindon, Kemble, Chippenham and, to a lesser extent, Bath as dormitory zones for commuters working in London. Traditional longer-distance commuters, using the classic electrified services from towns like Southend (35 miles), Haslemere (43 miles) or Brighton (51 miles), regard a 1hr journey time as perfectly acceptable. Commuters using an IC125 can get home to Didcot in 30min (53 miles), to Swindon in 48min (77 miles), to Kemble in 65min (91 miles) and to Chippenham in 60min (94 miles). While the IC125 has always been promoted as a 125mph InterCity train, it has also opened up a new commuter market for houses in Oxfordshire and the Cotswolds. While this revenue is attractive to BR, designing a train service to cope with the twin peaks of commuters and business travellers requires a concentrated daily use of resources for two busy periods. The 'outer-suburban' 125mph stopping service also makes heavy and unforeseen demands on power units and brakes.

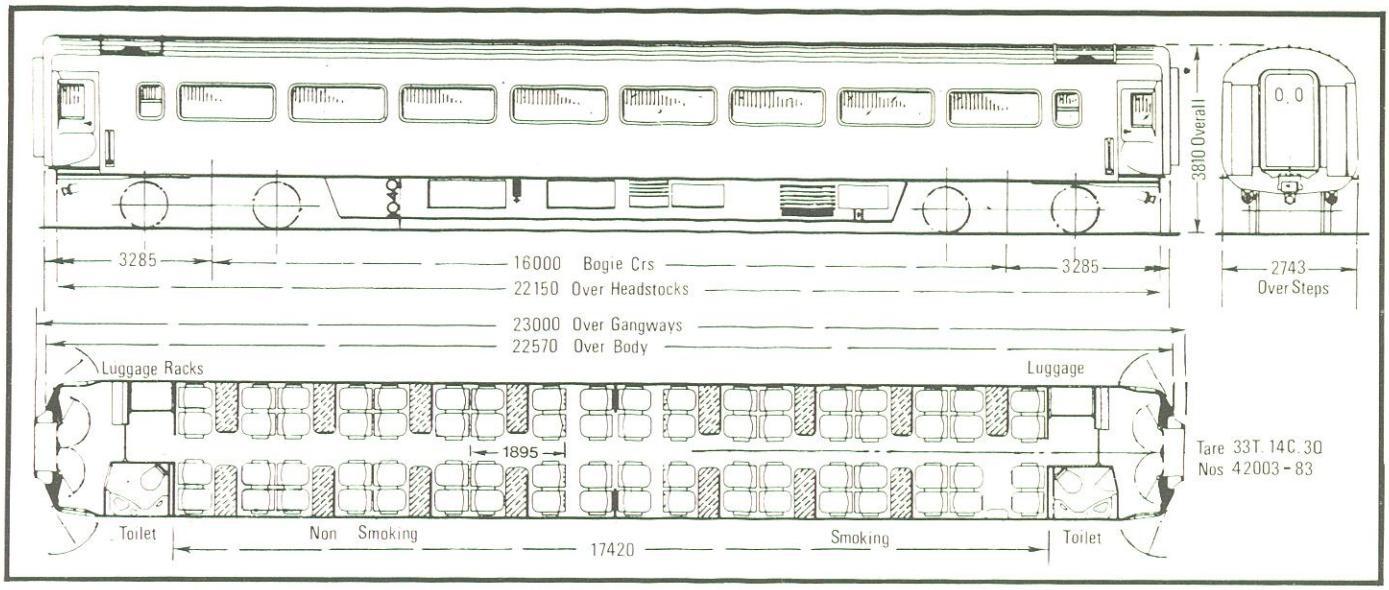
By late 1987 new business along the South Wales/Bristol-Paddington corridor had grown to the extent that the financial outlook for the sub-Sector had completely changed. Not only are sector obligations now being met, but a case for additional resources was made. The case for an extra IC125 unit was based on three factors: it enabled the sub-Sector to reduce its need for costly locomotive-hauled trains for basic services, it was able to provide an extra service to Paddington in the morning peak and organise three dedicated sets to cover Pullman workings.

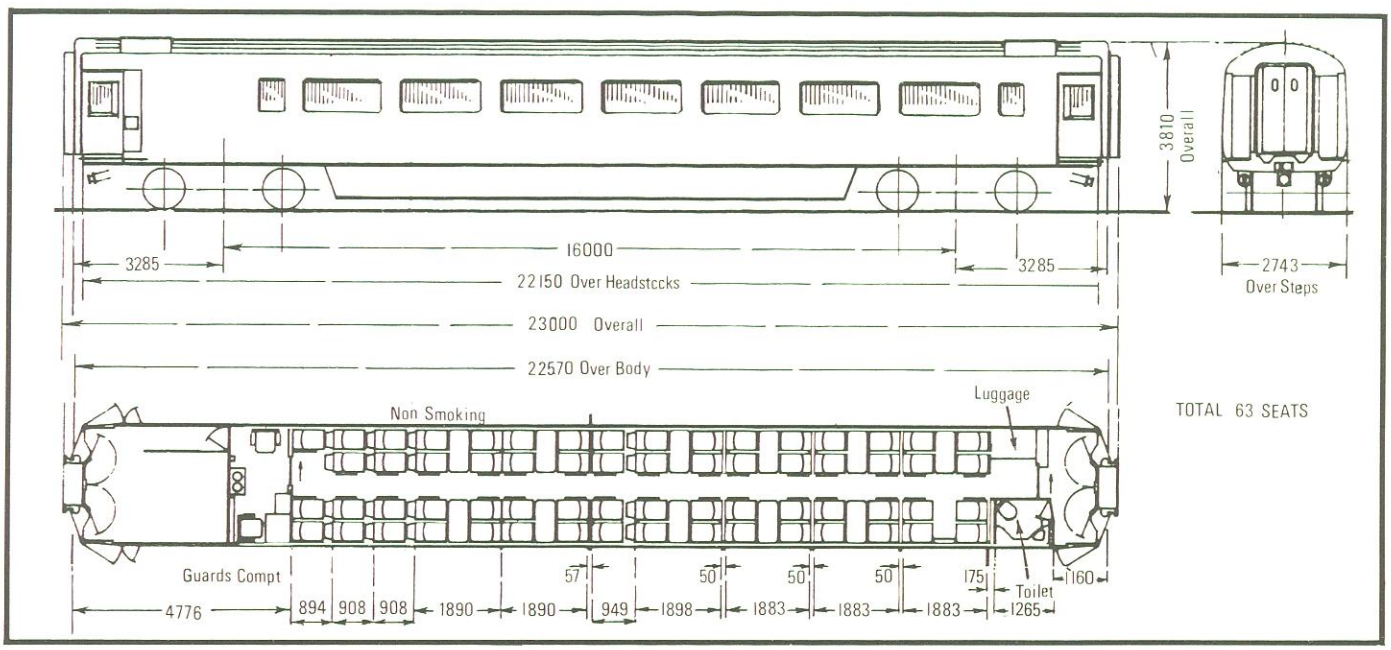
Today, the two busiest stations on the South Wales/Bristol-Paddington corridor are Bristol Parkway and Swindon, and both are showing continuing growth. Almost 1,000 passengers per day commute from Swindon. To provide for this business, the morning peak service was reorganised from May 1988 to provide a standard 15min 'clockface' service from Swindon to Paddington between 06.30 and 09.00. Calling points of these trains vary, but with an average time of 54½min for the 77.25 miles (average end-to-end speed 85.0mph) this is probably the fastest and most frequent commuter service in Europe!

As mentioned in an earlier chapter, the impact of the M4 motorway creamed off some off-peak leisure traffic between Bristol, Paddington and South Wales which is reflected in today's train service. The original three trains per off-peak hour have been cut back to two. Off-peak, the basic service has a slow train to Bristol (sometimes extended to Weston-super-Mare) calling at Slough, Reading, Didcot Parkway, Swindon, Chippenham, Bath and Bristol with an end-to-end time of 1hr 38min. Given six intermediate stops in a 118.5-mile 1hr 38min station-to-station journey, timings are very tight; Paddington to Slough — 18.5 miles in 13min (85.38mph); Slough to Reading — 17.5 miles in 12min (87.5mph); Reading to Didcot Parkway — 17.25 miles in 11min (94.1mph); Didcot Parkway to

*Below:*
Trailer First (TF).






*Top:*
Trailer Second (TS).

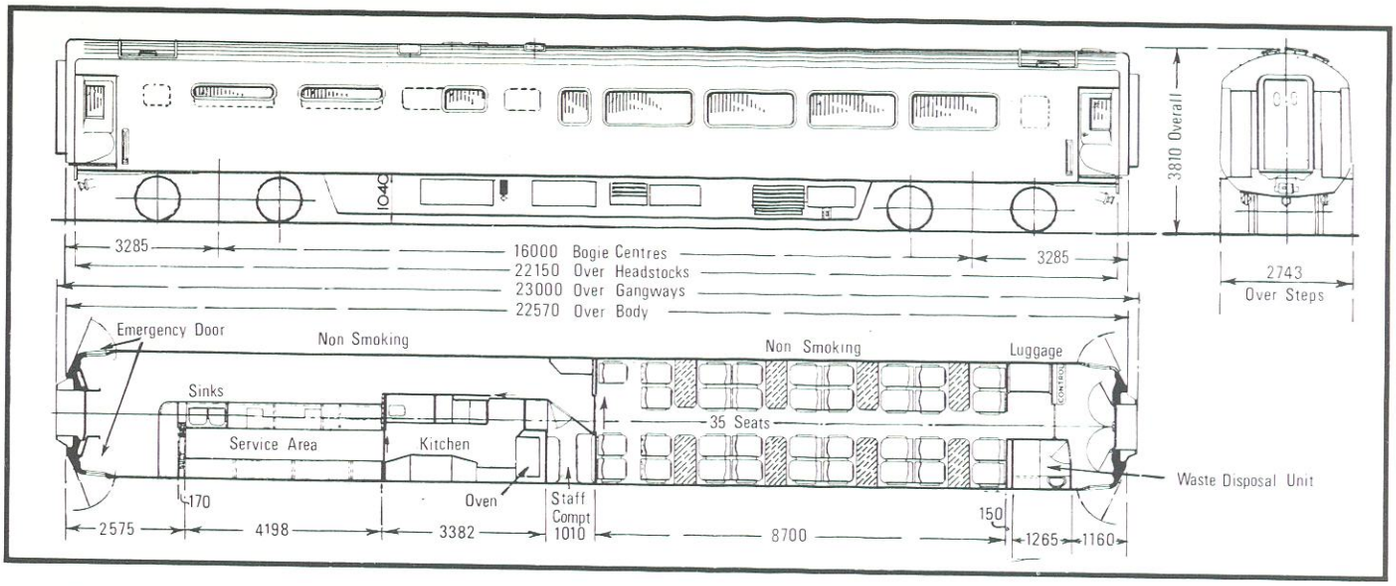
*Above:*
Trailer Guard Second (TGS).

Swindon — 24 miles in 19min (75.8mph); Swindon to Chippenham — 16.75 miles in 10min (91.36mph); Chippenham to Bath — 13 miles in 11min (78mph); and, finally, Bath to Bristol — 11.5 miles in 13min ( 53mph). The service to South Wales is hourly scheduled at XX.00 from Paddington, calling at Reading, Swindon, Bristol Parkway, Newport, Cardiff, Port Talbot, Neath and Swansea; journey times are 1hr 37min to Newport, 1hr 53min to Cardiff and 2hr 46min to Swansea. Return times from Swansea to Paddington are at XX.35 past each hour.

Timings of some of the business trains — which have fewer intermediate stops — are very fast. The 'Red Dragon Pullman' (06.37 from Swansea to Paddington) runs up from Bristol Parkway to Paddington in 68min at an average speed of 98.6mph. The evening 'Red Dragon Pullman' runs from Paddington to Bristol Parkway in a working time of 67min, equalling 100mph start-to-stop, and the 07.41 from Bristol (05.35 from Plymouth) runs through to Paddington in 1hr 24min with just two stops.

As the InterCity business has developed since 1976, HST services have been extended to towns not originally proposed for these trains. Cheltenham now has three IC125 services a day. Two run up in the morning and return from Paddington in the afternoon, with the third running out of London in the morning and returning in the afternoon. While these trains run at 125mph speeds between Paddington and Swindon, progress over the difficult speed-restricted, steeply-graded 36.5 miles between Swindon and Gloucester is slow. The Paddington-Cheltenham IC125s all have to reverse at Gloucester in both directions.

Another interesting service is the provision of three IC125s in each direction over the Cotswold line between Oxford and Worcester. Two services run up from Hereford to Paddington in the morning and back in the evening while the third is a mid-morning fill-in from Paddington to Worcester and back. These services are an example of the many penetrating journeys


3810 Overall
1040
3285
16000 Bogie Centres
22150 Over Headstocks
23000 Over Gangways
22570 Over Body
3285
2743
Over Steps
Emergency Door
Non Smoking
Non Smoking
Luggage
Sinks
Service Area
Kitchen
35 Seats
Oven
Staff
Compt
1010
Waste Disposal Unit
170
2575
4198
3382
8700
150
1265
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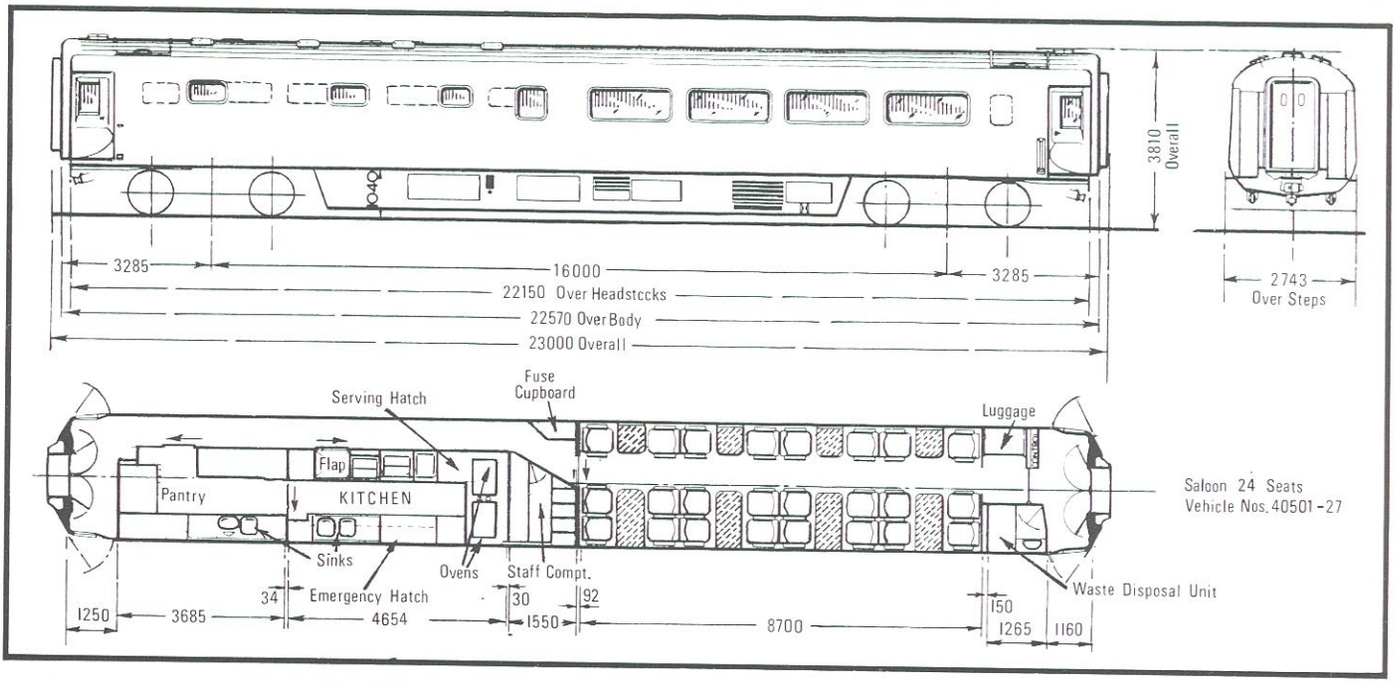
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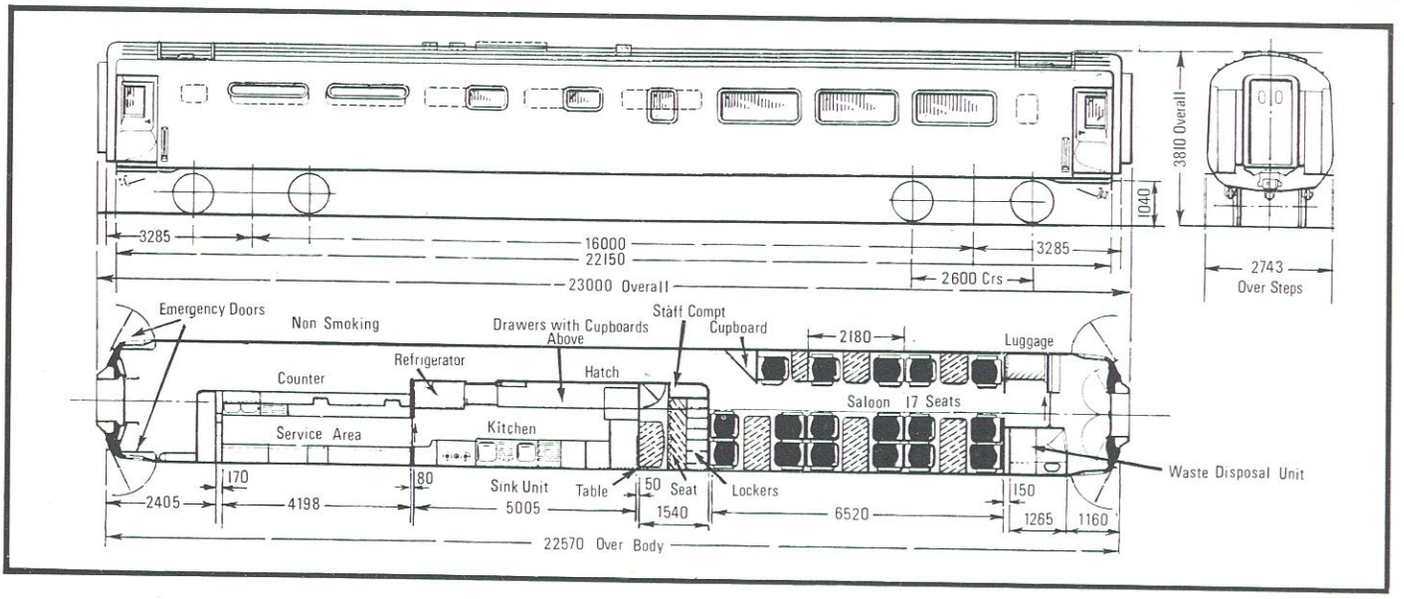
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Cupboard
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Luggage
Refrigerator
Counter
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Saloon 17 Seats
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where the InterCity and Provincial sectors jointly sponsor the business.

Delays to a number of major BR investment proposals slowed the on-going programme of route rationalisation and resignalling for the Berks & Hants route. By 1987, most of the work was completed and the line speed raised to 100/110mph for significant sections of the route. Over the years, as traditional British seaside towns have lost ground to the more sunny package holidays overseas, holiday business on the route to the West of England has declined. Even so, trains are still needed on some peak Saturdays. Overall there is a good baseload of year-round business travel up from Penzance, Plymouth, Exeter and Taunton. To improve the financial return from the route, InterCity reduced frequency from May 1986 and augmented the IC125s from 2+7 to 2+8 formations. The timetable structure became non-standard. With improved line speeds, journey times have been cut. Flagship of the West of England route — the 'Cornish Riviera' — now gets from Paddington to Plymouth in 2hr 52min (2hr 54min eastbound), with one stop at Exeter; booked time from Paddington to Exeter is 1hr 55min, an average speed of 90.65mph. Paddington to Penzance is completed in 4hr 43min. The 'Golden Hind Executive' — the business service up from Penzance and Plymouth to Paddington — also has a fast timing in both directions but makes more calls. A number of West of England IC125s run beyond Plymouth over the Provincial Sector-sponsored route on to Penzance.

To consolidate its position in the first class business travel market, InterCity relaunched its Pullman service in 1985, but these services were not introduced on to the Great Western sub-Sector until October 1987 when the 'Golden Hind' Penzance-Paddington service was upgraded. As mentioned in an earlier chapter, Pullman services need dedicated sets of stock, but the nature of the cyclic rosters on the Western Region ruled this out. However, with the provision of an extra unit in 1988 the Great Western sub-Sector worked out a programme of Pullman services. From May 1988 a Pullman service was reintroduced to South Wales with the 'Red Dragon Pullman' at 06.37 from Swansea and 17.59 from Paddington. At the same time it was decided to use the Pullman sets in the midday off-peak period for leisure journeys to Bath and Paignton (the 'West Country Pullman') and to Stratford-upon-Avon (the 'Stratford-upon-Avon Pullman'). These services are aimed at the upper end of the leisure market and should appeal to overseas visitors who wish to visit Bath, Oxford and Stratford. The conference market is also a target for these services. An unusual pattern of stops on the 'West Country Pullman', including a non-stop run from Paddington to Bath, has produced a start-to-stop speed of 103.5mph.

*Top left:*
Trailer Restaurant Second Buffet (TRSB).

*Left:*
Trailer Restaurant First Kitchen (TRFK).

*Bottom left:*
Trailer Restaurant First Buffet (TRFB).

*Below:*
HST set 253.005, seen here leaving Twyford with the 14.10 Paddington-Swansea in June 1977, has dual buffet cars. *Les Bertram*

## East Coast main line

Almost all of the East Coast main line timetable has remained on a regular departure basis, but because of the pattern of stops, standard times are not possible at all intermediate stations. Departures from King's Cross to either Newcastle or Edinburgh have left on the hour since the post-war revival of the East Coast route started in the 1950s. However, since the first IC125s came into service in 1978, many interesting changes have been made to the East Coast service.

However, the most important feature of the 1988-89 timetable was the impact of a completely revised track maintenance strategy on daytime journeys. While electrification of the East Coast main line was undertaken with relatively little impact on basic Monday to Friday journey times, the problem of accommodating routine engineering is a long-standing BR conundrum. Conditions in Britain preclude the operation of a seven-day timetable offering the same level of speed and journey times on each and every day of the week, as is the case in most of continental Europe. Because they have wider spacing between each pair of tracks and have considerable distances of trunk route signalled for two-way working, most European railways can carry out a large volume of routine engineering during the week without interrupting the flow of traffic to any significant extent. Tedious, time-consuming Sunday diversions — the bane of the British traveller — are unknown in Europe.

On most InterCity routes the engineer is given possession of the tracks from late on Saturday night through to late afternoon on Sunday, a period of about 20hr. Even with a 20hr blockage there is insufficient time to get the track back in a condition where full line speeds can be resumed on the Monday morning. Consequently, the work which was started on the Saturday cannot necessarily be completed and a temporary speed restriction has to be imposed with extra running time being allowed in the schedules to ensure punctual arrival. Necessary though it is, recovery time to offset the effect of engineering speed restrictions has to be kept to an absolute minimum if InterCity is to remain competitive. Prior to 1988-89, the total recovery time between King's Cross and Edinburgh was 24min.

With a view to reducing drastically the number of temporary speed restrictions and recovery time allowances, BR's engineers developed a new approach to track laying and reballasting known as production line relaying. Developed by the area civil engineer in Leeds, production line relaying can achieve in one weekend work which would have hitherto required four weekends and the imposition of a temporary speed restriction for the whole period of the work. Moreover, after the weekend work has been completed, it is now possible to reopen the route at the full line speed. Experience with production line relaying has shown that it is perfectly practical to reopen the line at the full 125mph. The key to the new technique is the Plasser & Theurer dynamic track stabiliser machine.

To gain the maximum benefit from production line relaying the engineers have to have a longer period of time in which to carry out their work. Accordingly, the time now given by the operators for a major track possession has been increased to a typical maximum of 30hr, but over four-track sections possessions can be extended through to 06.00 on the Monday morning. It entails starting the work on Saturday afternoon instead of late on Saturday night. According to the location, single line working is now introduced on parts of the East Coast route on Saturday afternoons according to the work schedule.

On the debit side, a number of East Coast services are now decelerated on Saturday afternoons as well as Sundays, but this is unlikely to affect revenue to any significant extent. The big gain for InterCity is the reduction in the total number of temporary speed restrictions and, with the benefit of higher handback speeds, reduction in recovery time allowances.

These allowances have now been reduced by about 10min producing the dramatic effect on journey times which are discussed below. The new running schedules — which will call for an even greater level of traction performance from the HST fleet — have produced a number of start-to-stop timings in excess of 100mph. For example, King's Cross to Retford is now timed at 81min at 102.6mph, Stevenage to Peterborough is 29min at 100.9mph and King's Cross to Grantham is 63min at 100.2mph. Other fast timings include King's Cross to York, 114½min at 98.8mph and York to Darlington, 27½min at 96mph.

With the impending introduction of electric traction between King's Cross and Leeds during the summer of 1988 and also to meet changes in the market, the East Coast main line service was completely redrafted for the 1988-89 timetable which started on 16 May. The basic East Coast daytime service is divided into three main sections: King's Cross and West Yorkshire which will change over to electric traction during the summer, King's Cross-Newcastle and Scotland and miscellaneous services such as King's Cross to York, Hull and Cleethorpes, and Leeds to Edinburgh. Until the end of 1989, when the new East Coast main line Mk 4 stock comes into service, the King's Cross-Leeds service will be worked by Class 91-IC125 'hybrid' sets. IC125s will work all other daytime services.

*Below:*
A full house of new-liveried power cars and vehicles enhances the HST's sleek lines. This is the 10.50 Paddington-Penzance, near Midgham, in July 1986. *Colin J. Marsden*

*Above:*
In May 1980, a Paddington-Bristol HST passes Bathampton Junction. *Colin J. Marsden*

*Below:*
A typically curvaceous Cornish line for the 10.10 Penzance-London HST passing Cothere in June 1980. *Colin J. Marsden*

In the 1988 summer timetable there are 14 IC125s from King's Cross to Edinburgh (16 on Fridays), six of which continue through to other locations in Scotland. There are 15 southbound services from Edinburgh to King's Cross. Edinburgh trains also serve Newcastle which has 24 (25 on Fridays) trains from King's Cross with a similar number in the opposite southbound direction.

The first northbound IC125 out of King's Cross is now at 06.05 for Aberdeen, followed by the 07.30 to Newcastle with Edinburgh departures at XX.00 from 08.00 to 18.00. During the off-peak periods the King's Cross to Newcastle IC125s depart at XX.30 and now have a fixed pattern of calls at Stevenage, Peterborough, Doncaster, York, Darlington, Durham and Newcastle. There are later services to Newcastle at 19.00, 20.00 and 22.00 — this last departure makes it possible to spend most of the evening in London and still be in Newcastle by 01.15. In addition there are two prestige trains — the 'Flying Scotsman' and the 'Tees-Tyne Pullman'. Flagship of the East Coast main line, the 'Flying Scotsman' departs from King's Cross for Newcastle, Edinburgh and stations to Aberdeen at 10.30. For many years the 'Flying Scotsman' ran non-stop between King's Cross and Newcastle — the longest non-stop run on BR. To improve loadings, additional stops at York in both directions were introduced. Arrival time in Edinburgh is 14.53, leaving again at 15.07 and arriving in Aberdeen at 17.24. Southbound departure from Aberdeen is at 07.55 going forward from Edinburgh at 10.30 and arriving in King's Cross at 14.53.

The overall schedule of the 'Flying Scotsman' is now the fastest ever between London and Edinburgh in 4hr 23min — an average speed of 89.8mph with two intermediate stops (if just one extra minute could be cut from this schedule it would produce an average of 90mph). Reintroduced in September 1985, the 'Tees-Tyne Pullman' was the former 'Newcastle Executive' — 06.52 from Newcastle and 17.30 from King's Cross — which was upgraded to full Pullman status. As the 'Tees-Tyne Pullman' makes several intermediate stops, it is not the fastest service on the route, but its major selling point is convenience, with businessmen getting into London at 09.53 in time for a morning's work. The average journey time of the 14 King's Cross to Edinburgh IC125s is 4hr 42min, an average speed of 83.65mph including intermediate stops.

A feature of Scottish timetables, developed since the early 1970s, has been the increasing number of penetrating workings of East Coast (and West Coast) trains beyond Edinburgh to other destinations, particularly Aberdeen. With the rapid growth of support activities for North Sea oil operations, Aberdeen became a very good market for BR. Initially, these extensions were locomotive-hauled, but when IC125s took over the East Coast main line, the opportunity for using them within 'marginal time' gave InterCity and ScotRail the motivation to develop some innovative marketing. As a first stage, ScotRail increased the number of through IC125 services from King's Cross (or Leeds) to Aberdeen. Next, Glasgow and Perth were added to the service. However, the most ambitious project was an IC125 service between King's Cross and Inverness, the centre of the Scottish Highlands. Following a test run at the end of 1982, plans were prepared for a new service named the 'Highland Chieftain', to start with the May 1984 timetable. Track geometry and permanent speed restrictions preclude the use of IC125s at their full 125mph over most of the ScotRail network. A maximum of 100mph is permitted for most of the route between Edinburgh and Glasgow and at a number of other locations. Even so, by exploiting the high power/weight ratio and superior acceleration and braking characteristics of HST, substantial journey time cuts were provided within the lower speed ranges. To maximise these benefits, ScotRail implemented a programme of low-cost line speed improvements, including differential speed restrictions which allows HSTs to run faster than conventional trains over specific locations. In 1988 the 'Highland Chieftain' left King's Cross at 12.00 and reached Edinburgh at 16.26, departing again for Inverness at 16.36. Arrival at Inverness, where the train is serviced during the night, was at 20.05. Departing again at 08.00, the southbound train (departing from Edinburgh at 11.30) reached King's Cross at 16.05. The 'Highland Chieftain' offers an excellent high-speed service between London and the Highlands and has been a considerable success, although the best loadings are achieved during the summer months. In the 1988 timetable, there were four services between King's Cross and Aberdeen and one between King's Cross and Glasgow in each direction.

## King's Cross-West Yorkshire

The 1988 timetable had IC125s running every hour in each direction between King's Cross and Leeds. In the morning peak, two trains started from Bradford and another from Harrogate with corresponding evening return services from King's Cross. When the East Coast HSTs were introduced, alternate trains during the day ran to or started from Bradford and Harrogate. These were subsequently withdrawn to release an IC125 for work elsewhere. This withdrawal was opposed by the Bradford City Council and the West Yorkshire Transport Users Consultative Committee, but not many through passengers used the trains to Bradford or Harrogate during the off-peak periods. So far as HST utilisation was concerned, the extra time taken to go from Leeds to Bradford or Harrogate and back had to be covered by an additional set. IC125s coming into Leeds from King's Cross turned round in about 30min for the return working to London. However, the need for through services from Bradford and Harrogate to King's Cross in the morning, returning in the late afternoon and evening, can be covered out of 'marginal time'. Time was also available for some of the six IC125s provided by Neville Hill depot for the first series of departures to King's Cross to run out empty for a Bradford or Harrogate start. Similarly, in the evening, some trains from King's Cross continued beyond Leeds to Bradford or Harrogate before returning to Neville Hill depot for the night.

The 1988-89 timetable included additional services to cope with business growth and now totals 16 trains in each direction between King's Cross and Leeds, plus an extra train each way on Fridays. In the 1988-89 recast, off-peak departures from Leeds are at XX.00 and from King's Cross at XX.20 until mid-afternoon when it changes to XX.50. Intermediate stops are standardised at Stevenage, Peterborough, Doncaster, Wakefield and Leeds. Track geometry and permanent speed restrictions between Doncaster and Leeds impose lower line speeds than those prevailing south of Doncaster. Average journey times are 2hr 16½min northbound and 2hr 24min southbound but some peak services are faster. A feature of the service is the spread of trains from early morning to the late evening. The first IC125 from Leeds is 06.00 arriving in King's Cross at 08.30 and the first northbound service from King's Cross is at 06.55. The last departure from King's Cross is 22.55. Such has been the success of the 'Yorkshire Pullman' that there are now four Pullman services in each direction — 07.15, 11.00, 14.00 and 18.00 from Leeds and 07.50, 10.20, 14.50 and 17.50 from King's Cross. The 07.15 Pullman from Leeds now gets into King's Cross in 2hr 05min with one stop at Wakefield; the timing from Wakefield to King's Cross is 1hr 52½min (93.7mph). As mentioned earlier,

*Left:*
The 08.45 from Leeds leans to the curve at Harringay as it approaches King's Cross. A feature of HST operation has been the spirited running close to the London termini.
*Michael J. Collins*

the King's Cross-West Yorkshire service will be worked by HSTs from May, but they will be progressively phased out and replaced by Class 91-IC125 sets during the summer. All HSTs should have left the King's Cross-Leeds route by the Autumn and so concluding an interesting chapter in the history of the East Coast main line.

Finally there was a group of miscellaneous East Coast IC125 services left over from the semi-fast trains mentioned in an earlier chapter. These were conceived, originally, as an hourly service of trains between King's Cross and York or Hull, calling at Stevenage, Huntingdon, Peterborough, Newark, Retford and (before the opening of the diversion) Selby, with connections into and out of other East Coast services either at Doncaster or York. They generated insufficient business to justify their retention. Instead, towns such as Grantham, Newark or Retford were served by selective stops by King's Cross-West Yorkshire trains. In the 1987 timetable, Stevenage and Huntingdon had an hourly electrified service provided by electric multiple-units. Two important pairs of trains in this group are the 'Hull Executive' (07.00 from Hull and 17.33 from King's Cross), and the 'Humber-Lincs' (06.12 from Cleethorpes and 18.04 from King's Cross). Starting at Cleethorpes this service was routed through Grimsby, Market Rasen and Lincoln to Newark where it joins the East Coast main line for King's Cross. Other interesting workings in this category included the 07.10 from Leeds to Edinburgh and 18.30 Aberdeen to Leeds. Two IC125s ran out empty from King's Cross to Peterborough from where they returned at 06.15 and 07.30 as commuter trains before starting their main day's work on the East Coast main line.

## Cross Country InterCity

This service is a mixed operation of IC125s and locomotive-hauled trains. Basically IC125s cover all Cross Country trains from Newcastle and Leeds to the southwest and South Wales, plus one service to Liverpool which runs under the wires from Birmingham. In the early 1980s, this series of trains was scheduled on a regular-interval basis, with cross-platform interchange at Birmingham New Street. This was subsequently abandoned. Cross-platform interchange was never very popular with certain categories of passengers — families with young children and senior citizens in particular, who did not relish the prospect of changing at Birmingham. Business on the route, being heavily dependent on leisure travel, suffered severely from the recession and coach deregulation to the extent that an hourly service was no longer viable. Instead, the service was rescheduled to give one or two through daily trains between the major centres in the northeast and northwest, and the southwest and South Wales. Another important change was made in 1982 when Doncaster, an important centre with its own originating traffic plus connectional opportunities with the East Coast main line and Hull, was brought into the Cross Country service. Trains from Newcastle or York run on the East Coast main line to Doncaster and diverge on to the branch route to Mexborough. At the same time, trains from Leeds were rerouted to run via Wakefield and Moorthorpe instead of via Cudworth. The longer distance involved was offset by the ability to run at the full 125mph between York and Doncaster over the newly-opened Selby diversion.

Ambitious plans to upgrade a significant length of the core of the North East-South West route between Sheffield and Taunton to speeds of 100/110mph were never implemented. However, upgrading to 100mph between Barnt Green and Westerleigh reduced journey times. It now seems unlikely that speeds above 100mph will ever be implemented, as the cost of providing a second driver is unlikely to be justified by the financial gains from the comparatively small saving in journey time.

By comparison with other IC125 routes, journey times on the Cross Country IC125 services are slow, but they are far superior to what could be achieved with Class 47 locomotives and Mk 2 stock. For example the 505½-mile Newcastle-Penzance run (11.25 from Newcastle and 07.35 from Penzance) was 1hr faster

when HST replaced a locomotive-hauled train in 1987. Another constraint with the Cross Country route is that many of the important centres which have to be served are closely spaced. Other Cross Country journeys include Leeds to Paignton and Bradford to Cardiff.

Two Cross Country HST workings are of particular interest. One HST works 'under the wires' at 06.16 from Bristol to Liverpool returning at 10.21 to Exeter. At one stage there were two HST services from the South West to Manchester and one to Liverpool, but they were subsequently cut back. From May 1988 the 'Cornishman' HST from Newcastle to Penzance has been extended to serve Berwick, Dunbar and Edinburgh — a journey of 585 miles.

Originally all Cross Country IC125 sets were based at Laira depot (Plymouth). Subsequent timetable changes, which curtailed some services west of Bristol, changed the allocation to four sets at Laira and six at St Philips Marsh, Bristol.

## Midland main line

Introduced in two stages between October 1982 and May 1983, the IC125 service between London (St Pancras), Leicester, Nottingham, Derby and Sheffield provided a much needed improvement to this neglected route. The complications of the old Midland Railway network offered three possible routeings between St Pancras and Sheffield — via Derby; via the Erewash Valley through Alfreton and Mansfield Parkway; or via Nottingham (reverse), and thence the Erewash Valley. Traditionally a number of through services between St Pancras and Sheffield had been routed via Nottingham, but the reversal extended the journey time for through passengers. InterCity services from St Pancras run to Sheffield via Derby or terminate at Nottingham. Provincial Sector trains serve most of the Erewash Valley stations, although a couple of peak-hour IC125s continue to provide a service to Alfreton and Mansfield Parkway.

While the transfer of IC125s to the Midland main line between October 1982 and May 1983 made it possible to introduce a much-needed package of improvements to this hitherto neglected route, the number of IC125s which could be spared from other routes had previously fallen short of the ideal number of trains needed for this service. It has been necessary to support the IC125s with some sets of locomotive-hauled stock although latterly this was only needed for commuter services. However, now an extra IC125 set has been transferred from Cross Country to the Midland main line, it is possible for InterCity to offer a completely revised service between London (St Pancras), Leicester, Nottingham, Derby and Sheffield which includes a number of train service improvements.

Although the Midland main line serves a large number of important centres — in particular Leicester, Nottingham and Derby — the route structure and geography precludes the best use of resources and infrastructure. Nottingham is a problem. So far as InterCity is concerned, Nottingham is located at the end of a branch line and thus it cannot be served in combination with Derby. Previously it was the practice to route some St Pancras to Sheffield trains to call at Nottingham, but this entailed a reversal at Nottingham and provided an unattractive journey time for passengers going through from London to Chesterfield and Sheffield. Three trains will continue to serve Alfreton & Mansfield Parkway and will reverse at Nottingham.

Given that the route north of Leicester has to have a separate service for Nottingham and for Sheffield (via Derby), the core of the Midland line is the 99 miles of route between St Pancras and Leicester. The route serves important towns at Luton, Bedford, Wellingborough, Kettering and Market Harborough. The new service has been designed to maximise the business on the core section of the route. With an additional set it is now possible to

*Right:*
Looking south at Abbots Ripton on 24 July 1984, as the 15.35 King's Cross-Edinburgh (right) and the 10.00 Aberdeen-King's Cross pass. Aerodynamic pressure pulse applies a force of over 1 tonne on each Mk 3 coach door. *Michael J. Collins*

standardise the off-peak service between St Pancras and Leicester on a 30min regular headway, although the choice of calling points is varied to suit the levels of business from the intermediate stations. The new timetable structure comprises a series of three services on a 90min headway: St Pancras to Nottingham, St Pancras to Leicester and St Pancras to Derby and Sheffield. These three 90min cycles overlap to give a 30min service between St Pancras and Leicester with standard departure times.

Because the morning peak business to London is more concentrated than the afternoon return flow, morning trains tend to make less intermediate stops and are consequently faster. The flagship service on the Midland main line is the very successful 'Master Cutler Pullman'. Departing from Sheffield at 07.20, with only two stops at Chesterfield and Derby, the Pullman is into St Pancras at 09.31 — the fastest ever time from these three stations. The non-stop run from Derby to St Pancras is 1hr 37min — an average speed of 79mph. In the evening the departure time of the 'Master Cutler Pullman' has been moved from 16.30 to 17.25 and will make an additional call at Wellingborough. The 'Master Cutler Pullman' set makes a midday off-peak journey to Sheffield at 10.25 from St Pancras and 13.34 from Sheffield.

The Midland main line is not near the top of the InterCity Sector's profitability ranking. The inability to service Nottingham, Derby and Sheffield traffic flows with one single trainload inflates unit costs on the route. While IC125s are the best option for the route, their earning potential is restricted by the line speed maximum of 100mph — in other words more trains have to be deployed for the volume of business on offer. However, the enormous cost of raising the line speed above 100mph cannot be justified at present.

On-train facilities have also evolved as HST has chased the changing travel market. The catering units for the initial HST fleets were the first to be built for over two decades, which allowed BR and Travellers Fare to base the design on the results of a complete reappraisal of on-train catering. There were two major objectives, greater flexibility, to cope with changing tastes in food, levels of service and demand, and higher standards of service for passengers travelling second-class, previously a neglected market. At the time, the contrast between what was offered to first and second-class customers was marked. In first-class there was china, clean linen and fresh food; all the buffet provided was a limited range of items and the inevitable queue. Also, since all British Rail catering cars combined the function of kitchen and buffet in a single vehicle, the car was always marshalled adjacent to first-class accommodation, close to the London end of the train. Second-class customers faced a walk through up to seven or eight coaches to be served. To overcome these deficiencies the catering space in each HST set was split into two half-coaches rather than a single dedicated vehicle.

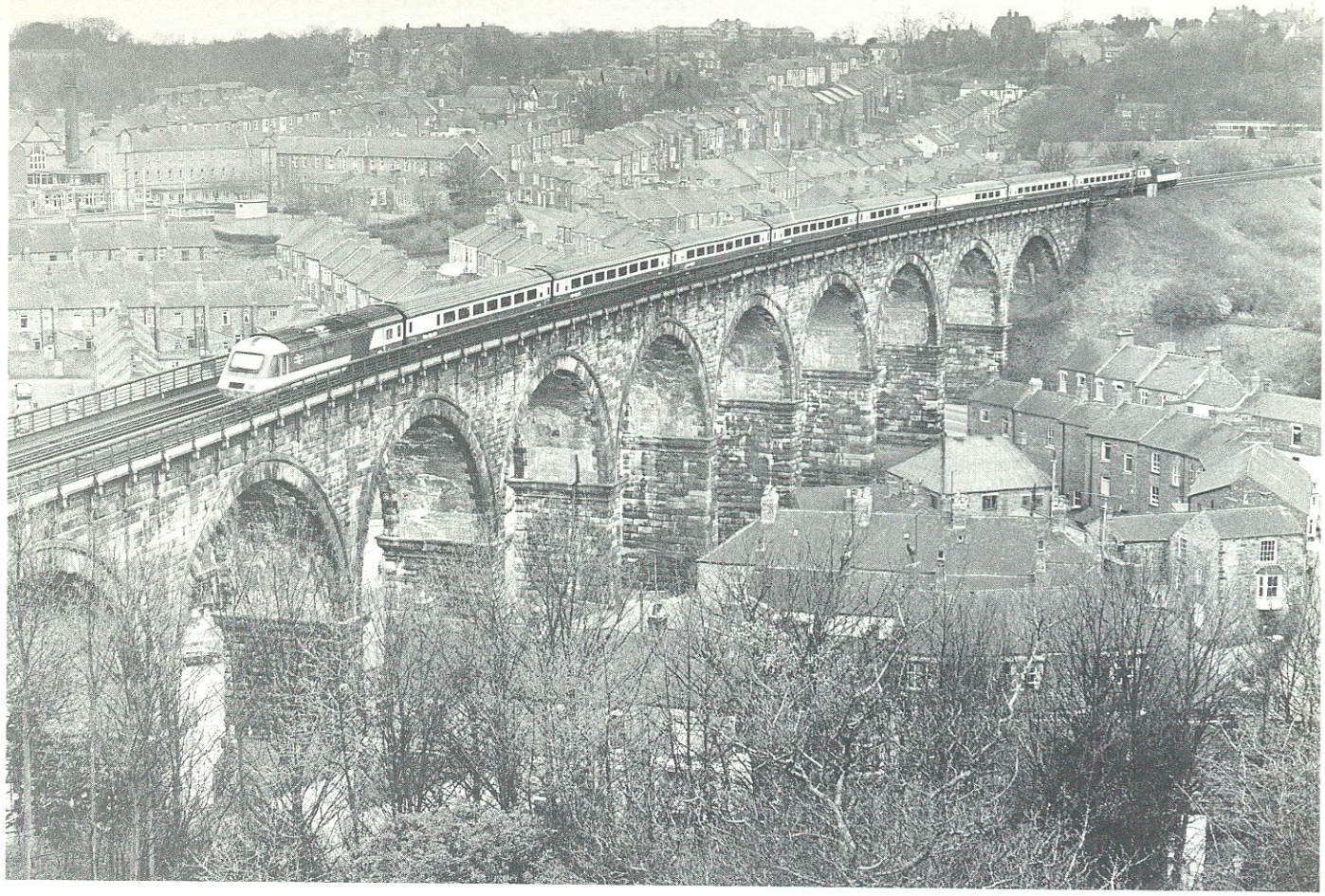
To avoid installing surplus seating, and with journeys considerably shortened, first-class passengers were to be served at their own seats. To cater for second-class passengers requiring full meals, a classic restaurant car configuration was retained, with half of the vehicle space used for a high-capacity kitchen and the other half for 24 unclassed seats. This vehicle — designated TRUK (Trailer Restaurant Unclassed Kitchen) — can produce a maximum of 120 meals at one sitting. Two cooks can, if necessary, work in the kitchen. Meal service is into the seating space and through to the adjoining first-class coaches. Seating in the TRUK is 2+1 in the standard first-class layout. A feature of the all-electric kitchen was the provision of 'Microaire' ovens for faster cooking — an important point with shorter journey times and quick turn-rounds.

While the TRUK was essentially a classic restaurant car, the new buffet vehicle — designated TRSB (Trailer Restaurant Second Buffet) — included a number of innovations. Half of the car had 36 seats in a standard (2+2) second-class layout. To provide more room in the buffet-half of the car, the catering area was extended through to the vestibule end. Designed to have a strong visual impact and provide a significantly wider range of food and drinks, the TRSB has been a great success. A problem with train buffets, unlike shore establishments, is that they have to cater for a varied clientele, including businessmen, holiday-makers, mothers with small children, students, and senior citizens. A 'social area' was created at the vestibule end where drinkers could congregate, leaving the main bar free for other business.

The large kitchen (also with a Microaire oven) can produce a range of hot snacks (pizzas, burgers, toasted sandwiches, egg, bacon, sausage, etc) and the clean bright bar area has ample display space. As BR's first buffet vehicle with the benefit of modern bogies and suspension, sound insulation and full air conditioning, the TRSB was a significant advance on Mk 1 catering cars. To provide easy access to the buffet, the TRSB was positioned in the centre of the second-class section of the train. The TRSB was designed on the 'take-away' principle with passengers taking food to their seats elsewhere in the train; disposable trays are provided for this purpose. The 33 seats in the vehicle were not specifically intended for passengers taking meals and were counted as part of the second-class seating total. Partly to allow the buffet staff to concentrate on preparing and selling more substantial buffet fare, but also to meet the needs of passengers who did not wish to leave their seats, a trolley service was part of the new buffet concept. Initially, this ran into objections from catering staff and it was some years before these industrial relations problems were solved.

Even before HST entered service, sales of full meals had started to decline to a serious extent. British Rail was no longer sure that the TRUK plus TRSB combination would be needed on every HST service, particularly on the Western Region. With passengers spending less, fewer services would require the capability to serve 120 main meals and these would mostly be on East Coast morning trains from the northeast and West Yorkshire to King's Cross. In compensation, sales of lower-priced buffet items were likely to hold up. To meet this changing situation, the designers revamped the layout of the TRSB by extending the kitchen space into one of the seating bays and replacing the 33 second-class seats with 17 unclassed seats in the same 2+1 layout as the TRUK. The bar space and social area were retained. Sufficient full meals could be supplied from the extended kitchen to meet the expected lower level of demand. This new IC125 catering car was designated TRUB (Trailer Restaurant Unclassed Buffet). While the TRUB was a more flexible catering unit and could operate with fewer staff, it had to be marshalled in the traditional position between the first and second-class sections of the train. Once again, second-class passengers faced a long walk to the buffet.

In the interim period between the authorisation of the 27 Bristol/South Wales sets in 1972 and the start of the service four years later, BR adopted the TRUB as the standard HST catering vehicle. At the same time, 20 out of the 32 East Coast sets retained the original two-car concept for busy Anglo-Scottish and business trains. Division of the East Coast fleet into 20 TRUK plus TRSB and 12 TRUB sets did not last for long. Sales of full meals continued to decline and the number of



*Above:*
A Classic East Coast scene with the 09.30 King's Cross-Newcastle crossing Durham viaduct.
*Michael J. Collins*

*Left:*
HST in heavy-haul country, with a St Pancras-Sheffield service passing a Class 58-hauled empty return working of fly-ash wagons from Fletton to Ratcliffe-on-Soar power station, in May 1985.
*Michael J. Collins*

*Below left:*
Until the Leicester resignalling scheme was completed, HSTs ran under semaphore signals through the 'Leicester Gap'. Here, a Derby-St Pancras working passes Wigston South Junction in October 1984. *Michael J. Collins*

two-catering car sets was reduced to seven and, finally, all but a couple of TRUK services were withdrawn. In the end, 113 catering cars were built for the HST programme; 56 TRUBs, 20 TRUKs and 37 TRSBs. Apart from three TRUKs retained for the two East Coast Pullman services, and one which was converted into the 'InterCity Executive Saloon', the remaining 16 cars were either modified for the Royal Train or converted to locomotive-hauled modular catering ('Cuisine 2000') cars for the West Coast main line.

Other changes have also been made. To provide more first-class seats on crowded business services, the seating in 48 TRUBs and four TRUKs has been changed from 'unclassed' to first class. A limited full meal service has been provided on some WR services by replacing the 35 second-class seats in nine TRSBs by 23 unclassed dining seats; these vehicles have been redesignated TRB. At the time of writing (and the position will fluctuate) the fleet of IC125 catering cars comprises nine TRB, 27 TRSB, 10 TRUB, 48 TRFB, four TRFK and the TLUK (Executive Saloon) — a total of 99 cars.

## 'Cuisine 2000': Modular Catering

Faced with the ever increasing cost of providing traditional-style train catering, with all food prepared and cooked on board, InterCity decided to opt for a modular system. In this, BR followed French Railways which introduced aircraft-type catering with the new 'Corail' stock in 1975. But where SNCF copied the airlines, BR combined the best features of aircraft and rail catering techniques for its new 'Cuisine 2000' system. While meals are supplied on trays, the food is served from trolleys on to china plates. Another important difference is that some food is still cooked on board. It is impossible to pre-cook and reheat the 'Great British Breakfast' — BR's most popular meal — without unacceptable loss of quality. Steak is also grilled on board. BR's system reduces food wastage, offers a higher standard and wider variety of dishes and staff can concentrate on serving the passenger rather than on food preparation. Traditional tasks, such as washing up, have been transferred to the train catering depot while sandwich making has been contracted out to private suppliers.

The first train on British Rail to be equipped for modular catering was the prototype Advanced Passenger Train (ATP-P), but was rarely used in public service. It was not until 1985 that BR eventually brought two prototype modular catering cars into public service. Their immediate success led to approval of a conversion programme for 58 locomotive-hauled cars for the West Coast main line and the adoption of the brand name, 'Cuisine 2000'.

Following test marketing on the West Coast, 'Cuisine 2000' will be extended to the IC125 fleet. The prototype conversion, with the same layout as the locomotive-hauled cars but a different electrical system, entered service on the 'Master Cutler Pullman' between Sheffield and St Pancras in May 1987. Because of the widespread changes in HST fleet deployment which will follow completion of the East Coast electrification, conversion of IC125 cars to 'Cuisine 2000' will have to be phased with care. The volume of business travel on the Western and Midland main lines is less than the East Coast so that provision for full meals service may be reduced. In any event, the 'Cuisine 2000' buffets will be of great benefit.

'Cuisine 2000' is particularly suitable for HST operations. One of the hazards of the IC125 timetable is the so-called set transposition. In the event of severe delay, say 45min or more, an HST will probably be unable to make its booked return working and another set may have to be substituted. Often, this entails the transfer of a catering crew from one set to another, frequently in the middle of meal preparation, in order that they can return to their home station. Before the transfer can be completed, all food, drink and stocks have to be checked and signed for by a new crew. With 'Cuisine 2000', all stocks can remain in the modules until the train set has been determined.

## IC125 Pullman services

To improve the quality of service offered to the first-class business traveller, InterCity decided to introduce an extended network of Pullman services from the start of the 1985 timetable. Full-fare first class ticket sales generate a significant proportion of InterCity revenue. These fares, which are not normally discounted, are very high compared with cheap 'Saver' tickets and in return the customer expects a very high standard of service. With the arrival of HST, the difference in quality between first and second class InterCity had narrowed. First-class passengers began to feel that they were not getting good value from their premium fares. Their main complaint was the quality of on-board service, which fell short of that offered by the major international airlines, the standard by which InterCity is judged. InterCity responded by initiating an 'Executive' package which included seat reservation, reserved car parking, meal vouchers and trolley service on-board for an inclusive price. This fell short of what was needed. However, as part of an InterCity re-launch in 1983, BR had refurbished and repainted the two Mk 2 'Manchester Pullman' sets. These, given some local promotion, increased business by about 20%. In the light of this experience, supported again by market research, InterCity decided to extend Pullman services to their key business routes.

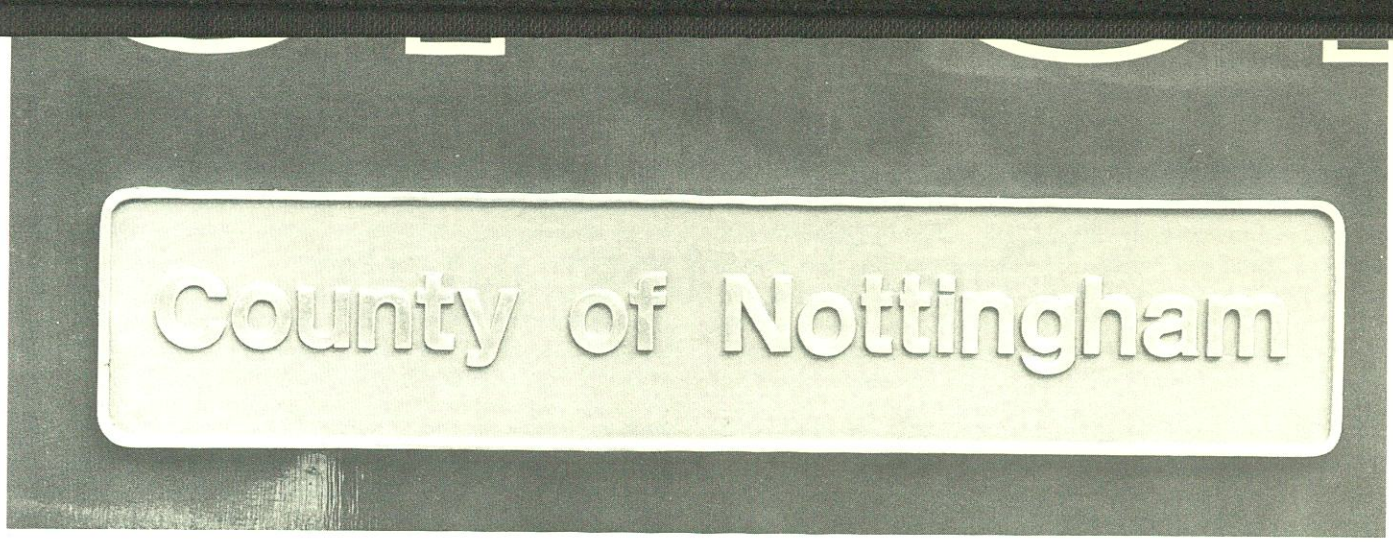
So far as the West Coast route was concerned, InterCity had already placed orders for a build of new Mk 3b first-class coaches and 18 of these were finished in Pullman style. High capacity Mk 1 kitchen cars, capable of producing the required number of meals in one sitting, were also refurbished to go into the new trains.

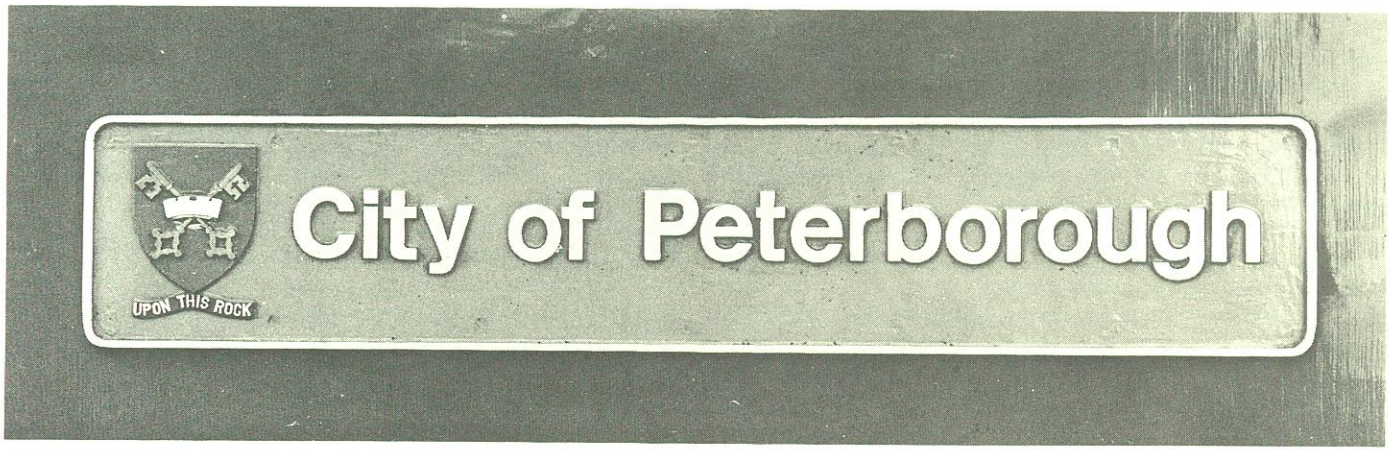
On HST-served routes, Leeds and Newcastle were obvious candidates for Pullman services, but organisation of an IC125 Pullman posed a number of problems. Special sets with extra first-class seating and two catering vehicles would have to be formed restricting their operating flexibility. Each of the two East Coast trains — the 'Yorkshire Pullman' and 'Tees-Tyne Pullman' — is formed as follows: PC, TF, TF, TRFK, TF, TRFB, TS, TS, TC, PC. This gives a total of 185 first and 267 second-class seats. Both trains have been an outstanding success to the extent that the 'Tees-Tyne Pullman' is often augmented by an extra vehicle in a 2 + 9 formation. Following the success of these HST Pullmans, the 'Master Cutler Pullman' between Sheffield and St Pancras was introduced from May 1987. While the three surviving TRFKs have been retained for the Pullman services, they will eventually be converted to 'Cuisine 2000'. For the present the Great Western sub-Sector Pullmans use the standard 2+8 formation, but extra first-class seating would be provided if business grows.

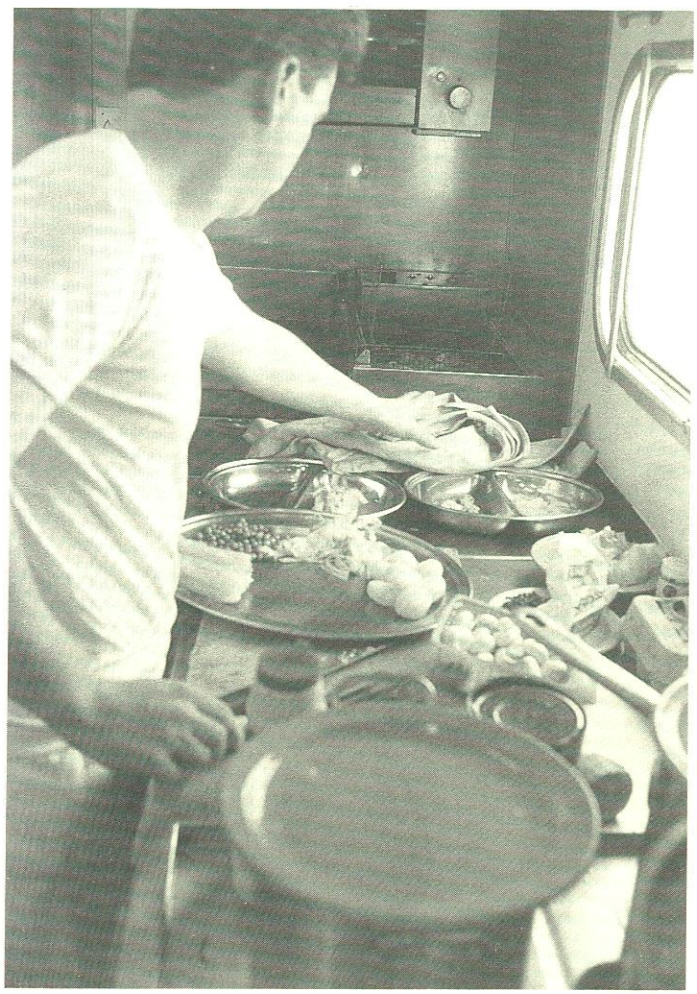
*Above:*
The 06.46 Newcastle-Plymouth North East-South West service runs through the industrial Midlands in October 1983. Avenue Coking Plant, near Clay Cross, is seen in the background. *Michael J. Collins*

*Right:*
Passing Standish Junction, south of Gloucester, in September 1984, is the 11.10 Paignton-Manchester Cross Country service. *Michael J. Collins*

*Below right:*
The 07.44 Dundee-Penzance at Five Ways station, Birmingham, in March 1984. *Michael J. Collins*



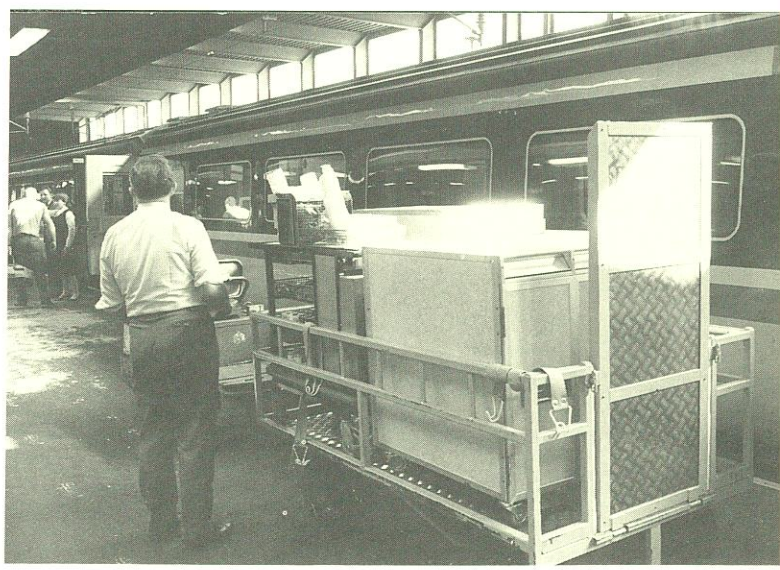



*Above:*
A feature of recent years has been the proliferation of named HST power cars. Nameplates illustrated are fitted to No 43052 *City of Peterborough* and No 43077 *County of Nottingham*. *Michael J. Collins*

*Left:*
Traditional-style train catering with on-train preparation and cooking of fresh ingredients, demonstrated in the kitchen car of the 'Aberdonian'. *Roger Ford*

*Below:*
With 'Cuisine 2000', prepared meals are brought to the train in these modular trolleys. Note the purpose-built trailer with drawbridge for direct loading. *Roger Ford*



CHAPTER EIGHT

# The Shortest Night

After 25 years of operating diesel traction, British Rail is coming to the conclusion that fleets of locomotives dedicated to a specific task and stabled and maintained at a single depot are likely to perform better than common user locomotives which roam the network, returning only occasionally to their home depot. Perhaps because the first diesels were promoted by the steam engineers who bought them as boxes on wheels, where you pushed the start button and went, any suggestion that diesel locomotives responded to tender loving care like any other machine was seen as an admission of failure.

Yet, in the 1960s, there was ample proof that close control of the maintenance of small groups of locomotives by dedicated personnel paid dividends. Export versions of the Class 37, for example, showed consistently higher availabilities than their domestic counterparts. On an African railway, the fleet of 20 or 30 new diesels would be the chief engineer's pride and joy and the care they received showed in their performance on the track. On BR, the Class 55 'Deltics' achieved previously unheard-of annual mileages and availabilities while they were looked after by the manufacturer's site engineers under the unique maintenance contract.

But for the main-stream BR engineer, such performances did not count because the locomotives were 'cossetted'. Real locomotives would work perfectly happily, indeed were expected to work, with the minimum of maintenance. This attitude, we now see, led to all sorts of problems, from smoky diesel engines to faults which were rectified but never cured. It was also out of step with other transport industries, where it was recognised that the price of more-capable equipment was higher standards of maintenance.

It was HST which broke the mould. Because it was a fixed formation train, the power cars and passenger vehicles had to be maintained together. This was good news for the power cars which, unlike diesel locomotives, would not be worked on in the inadequate conditions of 1960s vintage depots. Even better news was the construction of purpose-built facilities for the new trains and the allocation of sets to these depots. This ensured a high standard of maintenance for the new equipment.

Psychologically, the combination of fixed formation trains, tight diagramming and barely adequate fleets provided the incentive necessary to keep the maintenance teams working at top pressure, night after night. With pooled locomotives, if a particular unit was not ready, another could take its place on what was, to the depot staff, some anonymous train. In contrast, with the exception of those scheduled for longer examinations, every HST coming into a depot at night was earmarked for a specific train next morning. If the depot failed to turn out its full complement of HSTs, the staff knew that they had failed to keep faith with the travelling public.

Once this concept applies, the true role of the depot is recognised. Where the old-fashioned locomotive shed simply maintained locomotives, an HST depot is an overnight production line. Its 'product' is the next day's InterCity 125 service. And, as the long-serving depot engineer at Bounds Green always emphasises, it must be a 'quality product'. This emphasis on the product is reflected in the job title given to the engineers who are responsible for the daily work of the HST depots, providing round the clock coverage in three shifts. They are the Production Managers.

The three shifts run from 08.00 to 15.00, 15.00 to 22.00 and from 22.00 to 08.00 the following morning. For the InterCity business and its customers, this 10-hour night shift is all-important. For the Production Manager in charge it is usually a race against time and a challenge to engineering expertise and experience. As the opening of the Terrahawks TV series announced, it is invariably a case of 'expect the unexpected' on the night shift.

At Bounds Green, on 3 February 1983, the night's work began at 18.00 when the afternoon Production Manager telephoned HST Control at York to take down details of the sets due to come into the depot for servicing that night.

This information is listed on a defects sheet and, significantly, the first column gives the time of the train which each set is due to form the next morning. Some Bounds Green trains will begin their day's work at St Pancras or Peterborough and these are identified by the suffix SP and PE respectively.

The next column contains the set number. While power cars continue to be changed around, the sets of coaches tend to stay together.

Next comes the numbers of the power cars allocated to each set. This provides the basis for planning the service and allows for power cars which have been receiving attention during the day and will be ready for service.

The fourth column identifies each train by the 'headcode' of the up train it is working into King's Cross that evening. Some of these trains will not arrive at King's Cross until well after the night shift has started.

The final column gives the examination for which the set is due. Tonight, five of the 10 sets are due for the more-extensive 'A' exam which is carried out every three days.

There is also space on the sheet where defects can be listed. Two sets get three lines of comments each. This being 1983, but still in the grip of winter, the highlighted sets have power cars down for straightforward checks on coolant leaks and oil levels. Not until the unseasonably hot summer will the epidemic of engine overheating failures begin. The Production Manager also discusses with HST Maintenance Control the availability of power cars and rolling stock undergoing periodic maintenance at the depot.

Throughout this book, reference has been made to HST as a scarce resource. The East Coast route in general, and Bounds Green in particular, provide a graphic illustration of what 'scarce resource' means in practice. The total East Coast fleet is 105 power cars and 48 passenger vehicle sets (1983 figures). To operate the published timetable, the depots at Bounds Green, Neville Hill (Leeds), Heaton (Newcastle) and Craigentinny (Edinburgh) have to have 40 sets working each day. Not all sets return to the depots overnight. To provide early morning services some have to be berthed away from home. Thus, out of the 40 sets, four will be berthed at Derby, one at Cleethorpes,

two each at Hull and Aberdeen, and one at Inverness. Of the remaining home-based sets in daily service, Bounds Green is charged with providing eight, Neville Hill 11, Heaton seven and Craigentinny four.

Having met the timetable, the East Coast depots thus have eight vehicle sets and 25 power cars available for maintenance and overhaul. Of these, three vehicle sets and seven power cars will be undergoing their two-yearly works overhaul at Derby. The remaining five vehicle sets and 18 power cars are in the depots undergoing periodic maintenance and heavy cleaning. As the depot is more than occupied during the overnight examinations, periodic maintenance and heavy cleaning is restricted to the day shifts. The six shifts required are thus spread over three days.

Allocated to Bounds Green are 10 sets of passenger vehicles and 21 power cars. To satisfy the timetable, the maximum number of vehicles which can be 'stopped' for attention is three power cars and one set of passenger vehicles. Thus, the night shift Production Manager has very little scope for manoeuvre. For example, sitting in the depot on 3 September 1983 is power car No 87 which has suspected loose yaw dampers on its bogies. These control the tendency of the bogie to 'hunt' at speed. However, tomorrow it will have to replace No 82 which should have had a 'B' exam and a wheel-set change last night but, because of a power car shortage, had to be put back into service with only the 'B' exam completed.

The defect sheet is waiting for the night shift Production Manager, Richard Peck when he comes on-shift at 22.00. With 5 degrees of frost outside, the first thing he does is telephone the Ferme Park reception sidings to ensure that the roof tanks of all coaches have been drained. The Mk 3 coach has a modular toilet unit which is prefabricated and then lowered into place. Once part of the vehicle structure, it is virtually impossible to get at some of the plumbing in the narrow space between the toilet compartment's fibreglass walls and the steel shell of the coach. If a water pipe freezes, and splits or pulls off a connection, it is a very difficult rectification job which is best avoided by draining the plumbing before it can freeze.

The Production Manager's 'factory' are the six sets of tracks in the depot, numbered from nine to 14. These tracks, or 'roads', have pits running beneath them to provide access to the underside of the trains. They also have pits beside the track from which the underfloor mounted modules and the bogies and running gear can be worked upon.

The depot is divided into two areas. Despite the purpose-built facilities, these are referred to, traditionally, as 'sheds'. The servicing shed has four roads (9-12) with the outside pit on one side of the track only. The maintenance shed has two fully-pitted roads (13 and 14). Each shed has its own supervisor, reporting directly to the Production Manager. Which train is allocated to which road will depend on the work to be done. In general, the fully pitted roads in the maintenance shed will be reserved for those sets requiring an 'A' examination, since the improved side access simplifies the change of disc-brake pads.

Before the shift has barely begun, the Production Manager is grappling with the intellectual challenge of what might be called 'musical roads'. Allocation of trains between the precious six tracks has to be flexible. Power car No 87 is the first problem. While waiting to have the bearing pins in its yaw dampers replaced, its engine is also being given a new fuel injection pump. In its present position it is blocking access to a side-pitted road. There is also the problem of direction. Is it facing the same way as power car No 82 which it is due to replace? A further complication is the need to carry out a functional test on the

*Right:*
Emergency attention for a faulty door at Neville Hill. *BR*

brakes of the incoming set containing No 82. This is because the train has over-run a signal and a brake test is decreed, even though the driver has admitted liability.

That is not all. The doors at the north end of No 14 road are damaged and out of use. They cannot be left open in this weather, so trains must run into that road from the south — even though they reverse in off the Hertford branch from the north. Having worked out his strategy, Richard Peck returns to his office to discuss the night's movements with the shift-operating assistant.

With only six roads, the aim is to get the first trains in fast to fill up the shed so that the servicing teams can get to work. Once all the roads are full, Richard Peck will determine the priority of departures. This is a far from easy process. Unlike a normal factory, there is not a set time between the 'raw material' coming in and the finished product leaving. For example, at 22.46, Set 19 is rolling into the shed. This set will form the 08.50 off King's Cross tomorrow morning. On the other hand, Set 30 has yet to arrive. Set 30 will form the 07.33 PE, which means that its servicing has to be completed ready for the ferry driver to take the set at 01.00 — just over two hours away.

Bounds Green is, in effect, the second stage of a two-part servicing operation. When an empty HST leaves King's Cross or St Pancras at the end of its day's work, it first goes to Ferme Park reception sidings. There an inspector examines it and notes any defects on a green card. After this 'pre-inspection' the water tanks are filled and the power cars fuelled. The power car nose is also cleaned by hand. From there the train passes through the bodyside washing plant and on to the concrete apron where all the toilets are flushed through and any blockages cleared before the train runs to Bowes Park and then back into Bounds Green.

The first green card arrives at Bounds Green just after 23.00 and shortly after that Set 30 rolls into the depot. The frost outside has turned the water of the final rinse at the Ferme Park washing plant into an even film of ice which makes the paintwork gleam in the artificial lighting. At the same time, while Richard Peck is sorting out how the replacement of No 87's yaw damper pins is to be handled, a walkie-talkie message passes on the news that Set 25 is causing problems at the reception sidings. The defect sheet has already requested a check on a possible faulty diesel engine starter relay. Now, the other power car is refusing to start.

Next to arrive, at 23.23, is the set incorporating power car No 82. If the night goes to plan, this will be exchanged with

*Below:*
Under the arc lights, three HSTs stand overnight at Neville Hill. *BR*

No 87 which, even now, is having the worst of the loose yaw damper pins replaced; there may not be time for all the pins to be processed tonight. This set is due to form the 07.50.

Another complication comes across Richard Peck's desk. Late information has come in that the 08.15 SP will be carrying a group of VIPs to the Railway Technical Centre, Derby. This means that Coach G, in which the visitors are travelling, will require a heavy clean. This news having come in after the duplicated sheets detailing the night's workload had been circulated, the cleaning supervisor has to be informed of the extra work.

At five minutes to midnight, Richard Peck checks again with Ferme Park. The news is not good. Set 25 is still refusing to start and will thus have to be loco-hauled to Bounds Green. There is provision for three such locomotive workings a day in the timetable. It saves a team of fitters having to leave the depot and trouble-shoot in the open without the spares and test equipment which is readily available at Bounds Green.

The next train in is another requiring a fast turn-round as it will form the 05.45 to York. As it arrives, the Production Manager is underneath No 82, checking the brakes. Reference has been made in an earlier chapter to the policy of allowing one wheel-set in a train to operate with its brake isolated. York Control has advised that No 82 has one axle in this condition and has asked for a check to be made on the bolts securing the brake discs to the wheel-webs on the other axles.

All is well and, as Richard Peck emerges from the pits, there is more good news in the form of the engine in power car No 87 coughing into smoky life, the new fuel injection pump having been fitted. With the power car now mobile, the shunting supervisor is asked to move No 87 into road No 11, an instruction promptly cancelled when it is realised that this road has only one side pit.

Next comes a quick look round the stores. If a lack of a spare prevents a power car or coach from running, the depot files an 'urgent vehicle standing' (UVS) request. Before the new cost-effective maintenance policy was instituted in 1987, with the central parts complex at Doncaster, the average time to respond to a UVS was seven days. Tonight, additions to the spares strength include 20 dampers, 12 of which are already earmarked for the maintenance of Set 31 on day shift.

At 00.52, the last remaining road is filled as Set 24 rolls in and parks behind power car No 82. At 01.00 it is time for the first cup of tea of the night and the chance to review the game-plan. Down on the depot floor the situation is as follows:

| *Road* | *Train forming the* |
|---|---|
| 9 | 08.15 |
| 10 | 05.45 |
| 11 | 07.50 |
| 12 | 08.50 |
| 13 | 07.30 |
| 14 | 07.33 PE |

It is also time to speak to HST Control at York to compare notes. Further changes are necessary as a result. Control thought that Set 31 would be back in service today (the 4th) but it will not be ready until tomorrow. Set 26, which was scheduled to form the 08.00, is now going to be stopped for maintenance tomorrow night. If it stays on the 08.00 it will end up at Neville Hill. Instead, it will have to be put on one of the four out-and-home diagrams which are available for sets which need to be at Bounds Green to be worked on and have to be kept in service for a further day. These are the 05.45, 07.33 PE, 07.50 and 08.50.

When allocating sets, it has to be remembered that HSTs are not necessarily interchangeable. The East Coast main line sets are eight cars while the Midland main line services operate seven car sets transferred from the Western Region. In 1983, catering vehicle allocations also varied with duty. In the revised plan, Set 26 becomes the 08.50, displacing Set 19, which in turn becomes the new 08.04. Completing the round, Set 25, which is an East Coast eight-car formation, replaces Set 26 on the 08.00. This solves the problem of getting Set 26 back to Bounds Green after its day's work, but makes extra work for the Travellers Fare staff at the depot. Their task is to lay the tables for breakfast in the restaurant cars. The 08.04 is a small lay-up while the 08.50 is a large one. Thus, covers will have to be taken up and relaid.

At 01.15, the first train is ready for inspection. The Production Manager makes a quality check of the 07.33 PE, starting at one end and walking through to the other. He checks the cleaning, checks for loose seat squabs, peers into every toilet compartment. Next, he walks through Set 01, the 05.45 which is due out at 03.00. The energetic cleaners have reached the last first-class coach but beneath their feet there are problems with an air conditioning module. When the power is turned on, a contact breaker keeps tripping after about a minute.

While the servicing supervisor and his fitters run a series of tests on the offending module, Richard Peck grabs a sandwich, his meal-break interrupted by a series of phone calls. Then it is back down to the shop floor where the diagnosis on the air conditioning module is not encouraging. The electric elements which heat the air have been checked and are OK, as is the earth trip. Now the circuit breakers for the three banks of heating elements are being checked.

It is a time for decision, familiar to every engineer; whether to press on with the fault-finding or cut their losses and replace the faulty unit. The alternatives are discussed with both the maintenance and servicing supervisors and the fitter doing the work. Rapidly, the options narrow. At first the fitter reports that he can find nothing wrong. A check with the stores reveals that there is no spare module. The obvious solution is to buy more time by exchanging duties with another train — but which one? Set 01 has TRUK+TRSB catering vehicles, while the obvious exchange, the 07.45 SP needs a TRUB.

Fortunately, there is a spare coach in the depot yard and York Control agrees with Richard Peck's proposal that the offending coach (No 42111) is taken out of the train and the spare (No 42244) substituted. While this is being done, Set 19 becomes the 05.45, and Set 01 can take over the 08.04. It has been a busy four hours since the shift began.

At 02.31, the 07.33 leaves No 14 road, running late because its guard was delayed. The road is empty for just 7min before it is occupied by the dead Set 35 due to form the 08.00. For some reason, the arrival of an HST which cannot run under its own power attracts a small group of fitters and supervisors who watch it roll silently in. First into the cab is the Production Manager who borrows a reverser key and tries a start. The engine turns over with the characteristically listless manner of a power unit unwilling to fire. A traction inspector, who has just completed the brake test on the 07.50, has joined the group in the cab and, as the engine turns, disappears into the engine rooms. The Valenta coughs and rumbles into reluctant life, filling the roof of the shed in grey-black smoke, as the inspector juggles with the fuel racks.

Not everything is a problem. To get to the set's other power car at the far end of the shed, Richard Peck walks through the 07.30 on another inspection. This train is ready to go 44min before its scheduled 03.30 departure. Back on board the 08.00, the cause of the refusal to start has already been diagnosed — a tripped circuit breaker in the battery charger has let the batteries run down until they lack the urge to turn the engine. Just in case there is also a fault in the batteries they will be checked by an electrician. At 03.00 all the vacated roads have been filled and the situation is as follows:

| *Road* | *Train forming the* | *Situation* |
|---|---|---|
| 9 | 08.15 SP | Heavy clean for VIP party Coach G |
| 10 | 08.04 | Swapping trailer car with faulty air conditioning module |
| 11 | 07.50 | Sequence test started on power car No 87 which has replaced No 82 |
| 12 | 07.45 SP | |
| 13 | 07.30 | Ready to leave |
| 14 | 08.00 | Was 08.04 |

The tempo of work in the depot is accelerating. Having returned to his office to put in an UVS for a replacement air conditioning module for trailer car No 42111, Richard Peck returns to the shop floor as the 07.50 moves out with its new power car. It will be parked in the depot yard until needed for duty, so that its road is free for the incoming 08.50. Once again, the Production Manager is faced with bad news from his team. Joining the group alongside power car No 48, he finds that the battery charger circuit breaker was only part of the problem. The electrician reports that several cells in the battery have failed, and others have no electrolyte in them.

With the set due off depot at 06.50, there is around 3hr to solve the problem. It is a time for management decision. There are three cells in the depot spares compound but, according to the electrician, their condition is doubtful. A quick test in the spares compound confirms this verdict, and the decision is taken to change the complete battery with the full set of cells which the depot had been reserving for a battery change on power car No 82.

Now, there is a problem at the other end of the set. The suspected coolant pipe leak is due to a fractured elbow joint where the pipe joins the engine. The depot does not have the necessary spare so the decision is taken to take an elbow off power car No 85 which is in shops for a wheel-set change. It is a hard decision. Engineers like Richard Peck do not like what they call 'robbing' because if it is not watched carefully it can lead to units becoming what aircraft operators term 'hangar queens' — permanently grounded as a source of spares.

Once again, the 08.00 claims the Production Manager's personal attention. This time, a 50amp circuit breaker has failed on one trailer car. The stores has only 30amp or 60amp circuit breakers. The first reaction is to see if Old Oak Common HST depot can help. There is a flourishing private spares distribution service between all the HST depots in time of need. But time is running out, so the decision is taken to 'rob' the circuit breaker off coach No 42111, which was cut out of a set earlier because of an air-conditioning module fault. This is not as simple as it seems. With the temperature well below freezing, fitters cannot be expected to work on the coach in the open. Instructions are given to the depot shunter to bring No 42111 back inside.

It seems that the last trains in are causing most of the trouble, as the driver of the recently-arrived 08.50 complains of braking problems between Ferme Park and the depot. Repeated brake applications show that the braking system is working correctly, but the driver's views are respected and the decision is taken to ask the depot inspector to travel on the train for its run to King's Cross as a precaution.

Focusing on the Production Manager's role throughout the night shift means that the routine servicing and maintenance work which has gone to plan has been ignored. Where trains have been in for 'A' exams, scattered pads lining a road are a reminder of a disc brake pad change. Just after 05.00, the servicing supervisor is able to report that work on all the trains on the servicing roads has been completed.

At 05.44, Richard Peck makes a long telephone call to York HST Control detailing the work done on each train and its current status. Attention to detail has indeed been the key to the successful operation of the HST fleet at such high levels of utilisation. At the end of the call, Control is given a listing of the final service allocation. It provides a convenient summary of the night's work and the enforced changes resulting from the technical problems which have arisen.

| *Set No* | *Planned train* | *Actual train* |
|---|---|---|
| 17 | 07.45 SP | 07.45 SP |
| 42 | 08.15 SP | 08.15 SP |
| 01 | 05.45 | 08.04 |
| 24* | 07.30 | 07.30 |
| 30* | 07.33 PE | 07.33 PE |
| 18* | 07.44 PE | 07.44 PE |
| 02 | 07.50 | 07.50 |
| 26* | 08.00 | 08.50 |
| 25* | 08.04 | 08.00 |
| 19 | 08.50 | 05.45 |

While this call is underway, a message is placed on Richard Peck's desk. More bad news from Set No 25 — the circuit breaker robbed from the spare coach is also unserviceable. It is 06.00 and the set is due off depot at 06.50. Those two times are misleading; before the train can leave the depot, the driver has to go through his preparation routine and Set 25 is into preparation time already. This effectively rules out robbing another spare vehicle for a 50amp circuit breaker. There is no alternative to fitting the coach with a unit of the incorrect rating. Another call to HST Control at York is now needed so that Neville Hill, which will service Set 25 tonight, can be ready to fit a replacement circuit breaker.

With the 08.00 despatched, after a last-minute struggle with a recalcitrant air conditioning module cover, the depot is silent and the Production Manager can catch up with the paperwork — until the telephone rings at 07.19. On the way down to King's Cross, the driver of the 07.50 has reported a wheelslip indication with the power off. As described in *Chapter 4*, this could be an indication of incipient traction motor gearbox failure.

The initial reaction is to arrange for the train to stop at Alexandra Palace station (outside the depot) so that an

*Right:*
A busy scene on the night shift at Neville Hill with the depot shunter about to move a power car. *BR*

electrician with a spare wheel-slip electronics module can ride the set, check the system, and replace the module if necessary. Then is is remembered that the inspector, who would accompany the electrician, has already been committed to travelling on the 08.50 with its phantom brake problem. Instead, the electrician is given a footplate pass and races off to King's Cross to see if the problem can be diagnosed and rectified before the train reaches Alexandra Palace.

The final task of the shift is the completion of UVS requests for spares used during the night — the coolant elbow, 60amp circuit breaker and a microwave oven. As the day shift Production Manager takes over, the 07.50 pulls into Alexandra Palace and the electrician climbs down from the cab. After a fairly typical night, Bounds Green has got all its trains away.

In May 1985, a new factor was introduced into the HST servicing equation with the 'Yorkshire Pullman'. This injected a dedicated set with a special formation into the East Coast HST fleet. The chosen set (No 47) had three first-class coaches, a restaurant first kitchen car, a restaurant first buffet, two second-class coaches and a guard second vehicle. Its prime duty was the Leeds-London run in the morning and the evening return. In between, a return working to York was diagrammed. Compared with the 1,000 mile plus marathon runs in the HST diagram, the result was a relatively leisurely 770-mile day. However, offsetting this easement was the fact that, as a dedicated set No 47 had to meet the same diagram every day, denying the Neville Hill depot Production Manager the opportunity to swap duties in the event of problems. It is interesting to follow the progress of this one set through its nightly service, remembering all the time that elsewhere in Neville Hill depot, the full allocation of 'routine' HST service is in full cry.

At Neville Hill, the arrival procedure is the same as that detailed for Bounds Green, with the set washed, fuelled and watered and the toilets flushed before entering the servicing shed. Set 47 is one of the first in, on the night in question, leaving the fuelling point at 21.58 and arriving on-depot at 22.30. By 22.45 about a third of the 32-strong cleaning team is at work inside the set. Any litter not removed at the fuelling stop is cleared and the carpets vacuum-cleaned. Six fitters are at work on the set, two on each power car and two beneath the trailer cars. Their work is mostly preventative rather than corrective. Oil samples have to be taken from the diesel engines for spectographic analysis which will reveal incipient problems — hopefully before they can become the cause of catastrophic failure. Beneath the train there is the routine task of checking disc brakes for cracking and monitoring the length of existing cracks. Oil levels in the traction motor gear cases must be checked, a task much simplified by the addition of sight glasses, and topped-up if necessary.

At 23.35, the engine of one power car is fired-up to take Set 47 the short journey to the train maintenance shed where the carpets will receive their fortnightly shampoo and minor faults, not listed on the original defects sheet and found in the train servicing shed such as a missing spray tap in one toilet, will be rectified. While the manoeuvre is taking place, seat reservation labels and window stickers for the morning are being put in place.

Arrival at the maintenance shed at 00.10 is followed by two shampooing teams climbing on board with their hydromist machines. Shampooing 150yd of carpet is a long job, interrupted by a meal break at 01.15. The air conditioning is kept running to accelerate drying of the carpets. While the cleaning is in process, the application of seat reservation labels continues. It is not until 02.15 that the work on Set 47 is completed.

Lay-up of the tables in the Pullman is the responsibility of the train's catering crew and the first stewards climb on board at 04.50. The train was stocked with provisions during the previous evening at King's Cross and only fresh bread and rolls will be needed, to be loaded at Leeds. The chefs arrive and start cooking at 05.30 and an hour later all the tables are laid-up. Seven minutes early, Set 47 leaves the depot, at 06.45, for the run to Leeds City station where it becomes the 'Yorkshire Pullman'.

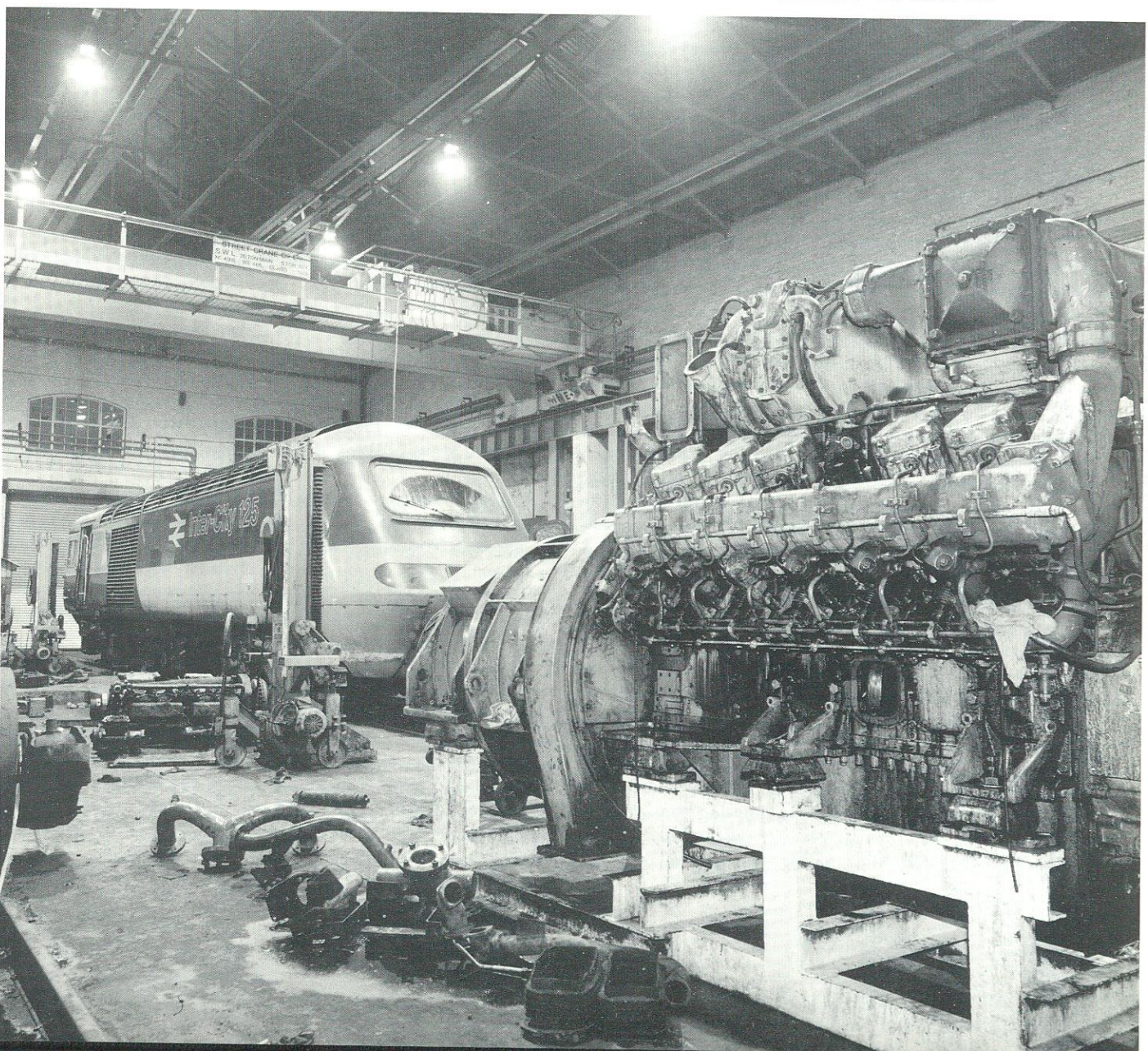
*Left:*
The overalls of the shunter show up as a blur as he couples up the power car. *BR*

*Below:*
A recently removed Valenta diesel engine sits on the depot floor in its support frame. Note the missing rocker box cover and open crankcase inspection hatches which suggest serious internal damage. *BR*

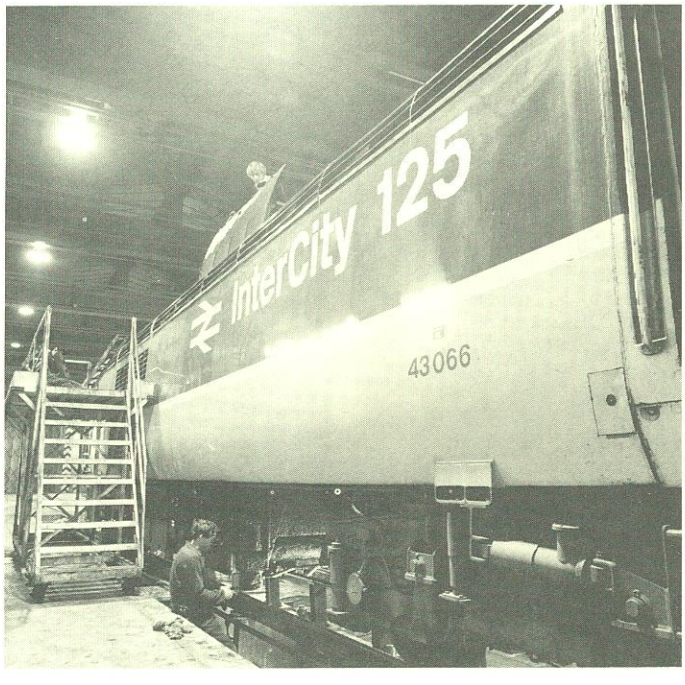
*Right:*
Around midnight, the often dour concentration on the problems facing the depot night shift is broken by the arrival of the invariably cheerful cleaning teams. While this is a posed publicity shot, the smile is typical. *BR*

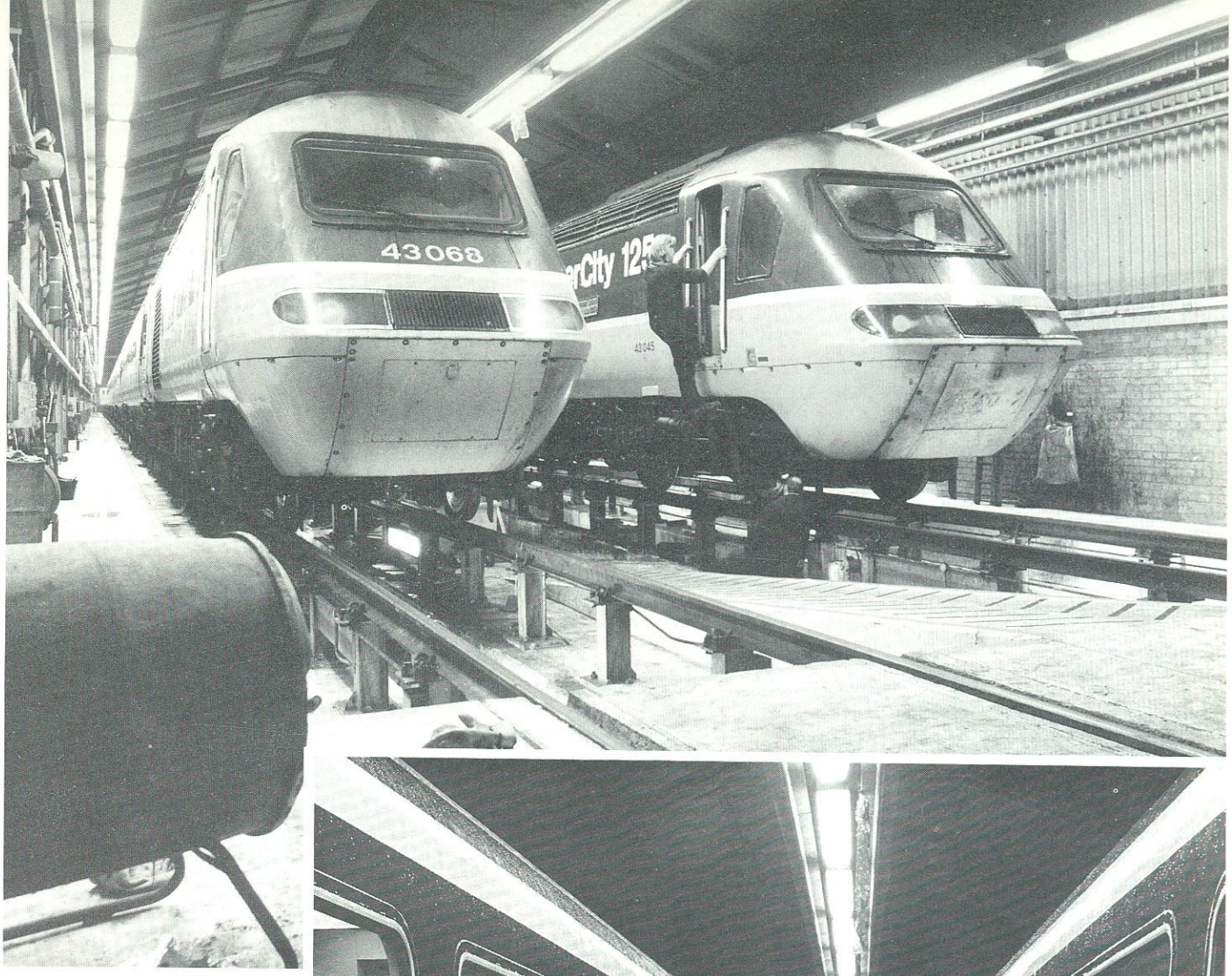
*Below right:*
Attention to underfloor equipment in a side-pitted road at Neville Hill. *BR*

*Below far right:*
Work being conducted on top of and underneath HST power car No 43066. *BR*



InterCity 125


InterCity 125
43066



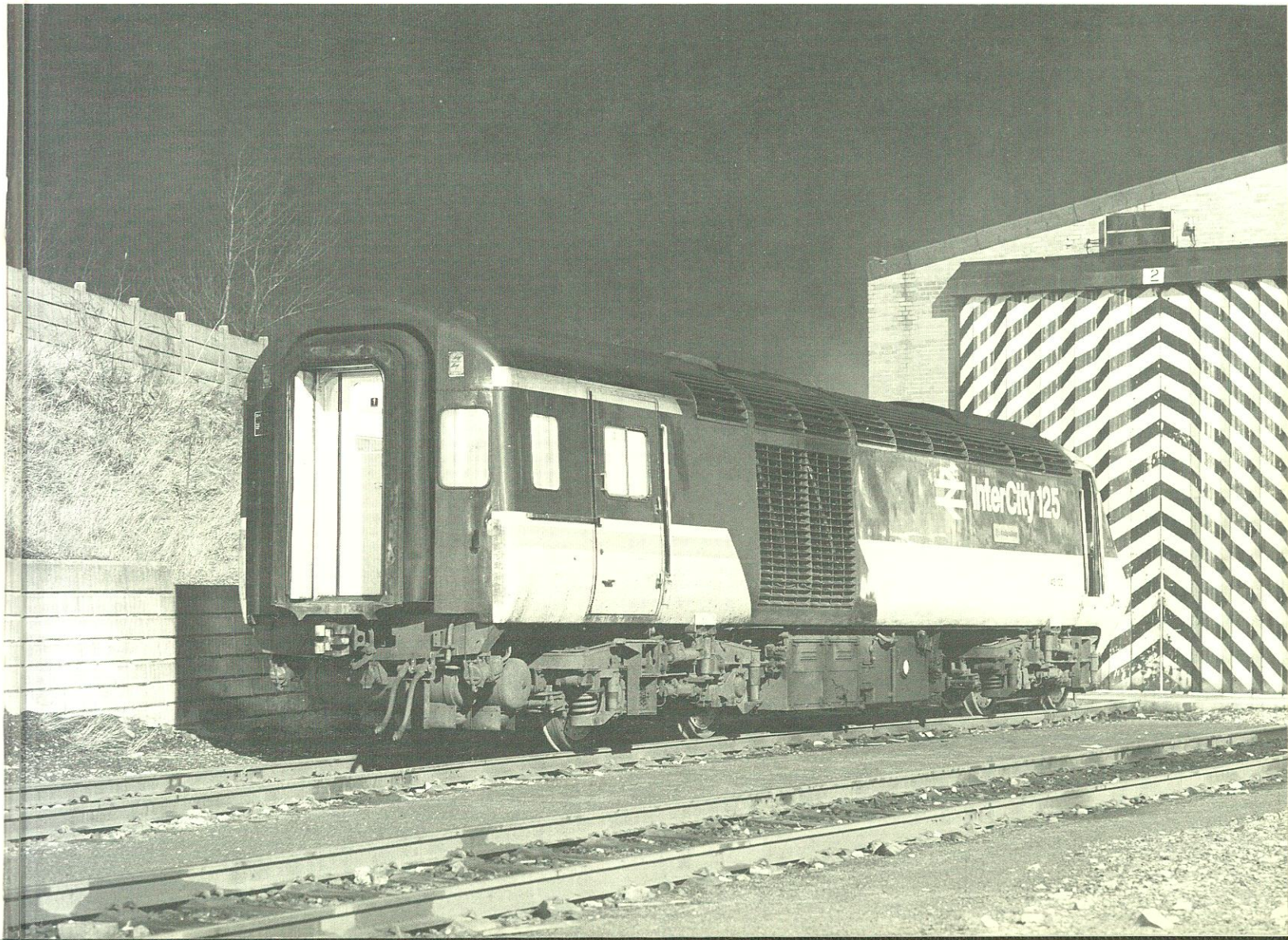
*Above:*
Two side-pitted roads at Neville Hill. Note the sloping ramps which give access for fork lift trucks and other wheeled equipment. *BR*

*Right:*
Cleaners' kit plus replaced curtains and other furnishings. *BR*

*Top right:*
The 'nosecone effect' — Kenneth Grange's front-end styling for the HST power car has become an all-time classic. *BR*

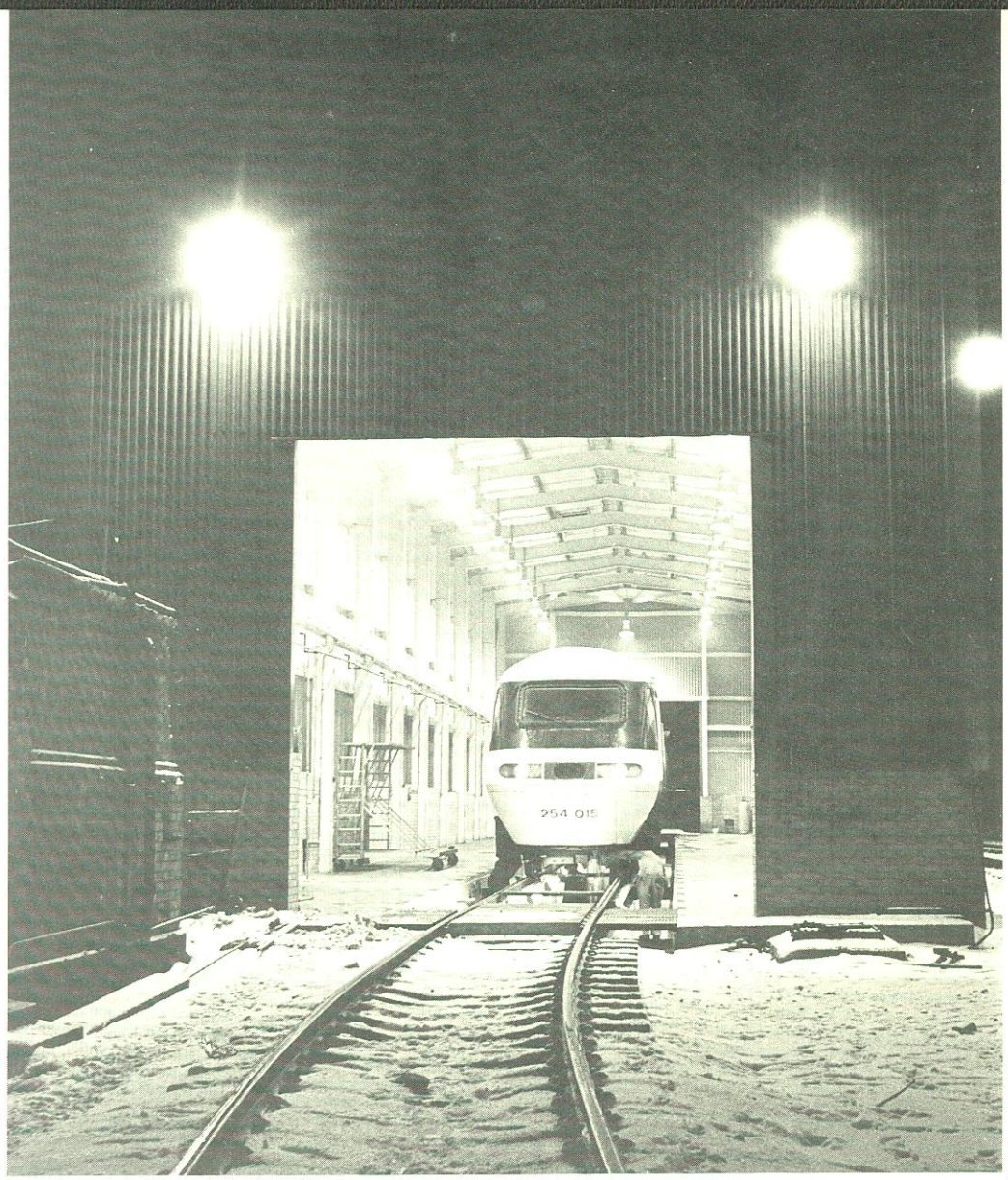
*Far right:*
As the night shift wears on power cars due for heavier exams, or needing more time for rectification than is available, are parked outside. *BR*

Inter City 125


Inter City 125

*Right:*
While special valeting equipment is used, much of the overnight cleaning is done by traditional manual methods. *BR*

*Below:*
A fine study of HST power cars. Note heavy chipping to underside of both noses, a reminder of the flying ballast created by the trains' 125mph slipstream. *BR*




*Left:*
In contrast to the major depots like Old Oak Common, Bounds Green and Neville Hill is this inspection shed built to service HSTs away from home at Aberdeen. It provides undercover accommodation with inspection and repair pits. These facilities are seen being used by unit No 254.015 just before midnight on 4 January 1979.
*C. P. Boocock*

*Below:*
Longer exams spread over into the day shifts. This is Bounds Green with a set which appears to have been towed in for attention.
*Brian Morrison*

CHAPTER NINE

# HST Performance

By Peter Barlow

With its high installed power, an HST follows closely the speed profile of a line. Hence, it is sufficient just to record times, calculate average speeds between adjacent recording points and then use these speeds to compare one run with another. Generally consistent running means that real interest lies in factors that can produce variations. These include the state of the unit, the weather, handling of acceleration from rest, braking, sharpness of driving at speed and the extent and location of checks. The runs selected have good overall times and are thus rare but not necessarily outstanding.

## 100mph plus

Clearly it is the over-100mph sections which show the trains at their best. Exceptionally the Midland must be included as it is such a lively racetrack. Correspondingly Newcastle-Edinburgh is omitted because speed is only fleetingly over 100mph and performance is largely eclipsed by that south of Newcastle. The North East-South West Cross Country route sadly does not match up. Rarely is there a sense of much effort in the running, partly as a result of slack schedules, with 16min of recovery time allowed between Doncaster and Bristol, for instance.

**Table A**
2+7, 1955 Paddington-Bristol, 7 May 1977

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | PADDINGTON | 0 | 0 | 00 | | (T) |
| 1.20 | Westbourne Park | | 2 | 29 | 28.8 | |
| 2.75 | Old Oak Common | | 3 | 48 | 70.6 | |
| 5.70 | Ealing Broadway | | 5 | 39 | 94.7 | |
| 9.05 | Southall | 8½ | 7 | 29 | 110.6 | |
| 13.20 | West Drayton | | 9 | 34 | 119.2 | |
| 18.40 | SLOUGH | 13 | 12 | 01 | 127.3 | |
| 24.20 | Maidenhead | 16 | 14 | 46 | 127.0 | |
| 30.95 | Twyford | 19 | 17 | 57 | 127.2 | |
| 35.95 | READING | 21½ | 20 | 28 | 118.5 | |
| 38.60 | Tilehurst | | 22 | 18 | 87.1 | |
| 41.50 | Pangbourne | | 23 | 57 | 105.5 | |
| 48.40 | Cholsey | | 27 | 22 | 121.3 | |
| 53.10 | DIDCOT | 31 | 29 | 33 | 128.6 | |
| 60.35 | Wantage Road | | 33 | 00 | 126.3 | |
| 66.50 | Uffington | | 35 | 53 | 128.0 | |
| 71.45 | Shrivenham | | 38 | 14 | 126.6 | |
| 77.25 | SWINDON | 43 | 41 | 12 | 117.5 | |
| 79.95 | MP80 | | 42 | 41 | 108.8 | |
| 83.05 | Wootton Bassett Jct | 46½ | 44 | 34 | 98.4 | |
| 86.95 | Brinkworth | | 47 | 08 | 91.4 | |
| 89.70 | Little Somerford | | 48 | 35 | 113.8 | |
| 94.20 | Hullavington | 53 | 50 | 51 | 119.1 | |
| 99.95 | Badminton | | 53 | 52 | 114.6 | |
| 104.55 | Chipping Sodbury | | 56 | 17 | 113.2 | |
| 107.10 | Westerleigh Jct | 60 | 57 | 44 | 106.8 | |
| 109.80 | Winterbourne | | 59 | 13 | 108.4 | |
| 111.75 | BRISTOL PARKWAY | 62½ | 60 | 36 | 86.3 | |
| 112.80 | Falton | | 61 | 45 | 52.7 | |
| 115.95 | Stapleton Road | (½) | 64 | 42 | 64.7 | |
| 117.60 | BRISTOL TM | 70 | 67 | 35 | 33.7 | (2½ E) |

## Bristol/South Wales: first experiences

The 'Jubilee Special' of 1977 (*Table A*) gave an early benchmark of what could be done flat out with the full seven-trailer

**Table B**
2+7, 13.28 Paignton-Paddington, 26 May 1980

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | BRISTOL TM | 0 | 0 | 00 | | (5½L) |
| 1.35 | MP117 | | 2 | 48 | 28.9 | |
| 4.60 | Keynsham | | 5 | 09 | 83.0 | |
| 9.15 | Tiverton TWE | | 8 | 10 | 90.5 | |
| 11.45 | BATH SPA | 10½ | 10 | 39 | 55.6 | (5½L) |
| | | | | | | (5L) |
| 2.30 | Bathampton Jct | | 2 | 44 | 50.5 | |
| 7.75 | Box Tunnel E End | | 6 | 17 | 92.1 | |
| 10.75 | Thingley Jct | | 8 | 05 | 100.0 | |
| 12.95 | CHIPPENHAM | 10½ | 9 | 59 | 69.5 | (4½L) |
| | | | | | | (4L) |
| 1.30 | Langley Xing | | 1 | 57 | 40.0 | |
| 6.20 | Dauntsey | | 5 | 01 | 95.9 | |
| 10.85 | Wootton Bassett Jct | | 7 | 27 | 114.7 | |
| 14.95 | MP79 | [4½] | 9 | 39 | 111.8 | |
| 16.65 | SWINDON | 17½ | 12 | 42 | 33.4 | (IE) |
| | | | | | | (½E) |
| 1.30 | MP76 | | 2 | 15 | 34.7 | |
| 5.80 | Shrivenham | | 5 | 08 | 93.6 | |
| 10.75 | Uffington | | 7 | 37 | 119.6 | |
| 16.90 | Wantage Road | | 10 | 31 | 127.2 | |
| 20.75 | Steventon | | 12 | 19 | 128.3 | |
| 24.15 | DIDCOT | 15 | 14 | 50 | 81.1 | (½E) |
| | | | | | | (1E) |
| 1.70 | Moreton Cutting | | 2 | 18 | 44.3 | |
| 4.70 | Cholsey | | 4 | 14 | 93.1 | |
| 8.40 | Goring | | 6 | 14 | 111.0 | |
| 11.60 | Pangbourne | | 7 | 47 | 123.9 | |
| 14.50 | Tilehurst | | 9 | 11 | 124.3 | |
| 17.15 | READING | 12½ | 12 | 37 | 46.3 | (IE) |
| | | | | | | |
| 2.00 | MP34 | | 2 | 47 | 43.1 | |
| 5.00 | Twyford | | 4 | 43 | 93.1 | |
| 11.75 | Maidenhead | | 8 | 09 | 118.0 | |
| 15.05 | Burnham | | 9 | 42 | 127.7 | |
| 17.55 | SLOUGH | 12½ | 11 | 42 | 75.0 | (1½E) |
| | | | | | | (1E) |
| 2.20 | Langley | | 2 | 43 | 48.6 | |
| 5.20 | West Drayton | | 4 | 38 | 93.9 | |
| 9.35 | Southall | | 6 | 50 | 113.2 | |
| | | | sigs | | 99.7 | |
| 12.70 | Ealing Broadway | | 8 | 51 | | |
| | | | sigs | | 74.0 | |
| 17.20 | Westbourne Park | [4½] | 12 | 30 | 25.0 | |
| 18.40 | PADDINGTON | 18½ | 15 | 23 | | (4E) |

Overall times:
Bristol-Paddington, 98min 39sec (72.0mph average)
Swindon-Paddington, 59min 46sec (77.6mph average)

*Right:*
While semaphore signalling remained on the Midland main line speeds could not be raised significantly. Completion of the Leicester area resignalling scheme during 1987 has paved the way for accelerations on the line. In this 1983 view HST No 253.027 storms through Syston Junction with the 15.00 Sheffield-St Pancras.
*Brian Morrison*

formation. Later record runs have tended to be made with reduced formations and some speed dispensations, which this one was not. The Badminton route was chosen for the fastest possible schedule, as was also the case for the famous 'Top of the Pops' event in August 1984 when overall time was 62min 36sec.

While the 'Jubilee' run was consistently good throughout, parts of it are easily capable of being equalled on ordinary journeys — indeed, several speed restrictions have been raised subsequently between Brinkworth and Westerleigh. That the present point-to-point timings, free of recovery, add up to 68min makes the point nicely. Nevertheless, an actual run from London to Bristol at an 104.4mph average was pretty breathtaking in 1977.

The 1980 (*Table B*) log is a typical 'all stations' run, with a 5min late start, no checks other than inwards from Southall and 4min early arrival. Whereas the 'Cheltenham Flyer' very occasionally beat the hour up from Swindon, the HST manages it easily with three stops on the way. Quite remarkable start-to-stop averages over short distances are achieved; 97.7mph Swindon to Didcot and 90mph Reading to Slough on this occasion. Runs ending at Swindon and Reading are inevitably slower because of approach-released signal aspects into loop platforms, costing about 1min each compared with straight station stops on the main running line. These Western Region 10-15min sectors between stops are a major cause of higher than normal stress on the HST which was designed for sustained high speed running. As a point of fine detail, the platforms at Paddington were shortened in July 1984 and 0.05 miles now has to be deducted from the distance shown in these particular logs.

## East Coast: premier line in speed terms

No apologies are made for including the record run from Newcastle to London of the 'Tees-Tyne Pullman' launch in September 1985, averaging 115.4mph overall (*Table C*). Other logs have been pubished, but as the ultimate in HST performance this book would be incomplete without its inclusion here. The times on this occasion cannot be equalled in ordinary practice; the line limit was raised to 140mph in places and

**Table C**
2+7, 11.10 Newcastle-King's Cross, 27 September 1985

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | NEWCASTLE | 0 | 0 | 00 | | |
| 1.20 | MP79 (Bensham) | | 2 | 16 | 31.8 | (T) |
| 4.45 | Tyne | | 4 | 36 | 83.6 | |
| 8.30 | Chester le Street | | 6 | 45 | 107.4 | |
| 13.95 | DURHAM | 11 | 10 | 13 | 97.8 | |
| 18.10 | MP62 (Croxdale) | | 12 | 58 | 90.5 | |
| 23.20 | Ferryhill | 17 | 16 | 01 | 100.3 | |
| 30.55 | Aycliffe | | 20 | 02 | 109.8 | |
| 35.95 | DARLINGTON | 24½ | 23 | 09 | 104.0 | (1½E) |
| 41.15 | Eryholme | | 25 | 56 | 112.1 | |
| 50.15 | Northallerton | 31½ | 30 | 05 | 130.1 | |
| 57.90 | Thirsk | | 33 | 38 | 131.0 | |
| 64.75 | Pilmoor South | | 36 | 40 | 135.5 | |
| 70.60 | Tollerton | 41 | 39 | 13 | 137.6 | |
| 76.90 | Skelton Bridge | | 41 | 56 | 139.1 | |
| 80.10 | York | 47½ | 44 | 54 | 64.7 | (2½E) |
| 82.00 | Chaloners Whin | | 46 | 59 | 54.7 | |
| 85.60 | Colton | | 49 | 06 | 102.0 | |
| 93.90 | Hambleton | 56½ | 53 | 07 | 124.0 | |
| 101.35 | Heck | | 56 | 30 | 132.1 | |
| 108.30 | Shaftholme | | 59 | 39 | 132.4 | |
| 112.60 | DONCASTER | 65 | 61 | 42 | 125.9 | (3½E) |
| 117.25 | Rossington | | 64 | 04 | 117.9 | |
| 124.60 | Ranskill | | 67 | 47 | 118.7 | |
| 130.00 | RETFORD | 73½ | 70 | 21 | 126.2 | |
| 136.65 | Tuxford | | 73 | 44 | 117.9 | |
| 142.25 | Carlton | | 76 | 22 | 127.6 | |
| 148.45 | NEWARK | 83 | 79 | 18 | 126.8 | (3½E) |
| 153.25 | Claypole | | 81 | 49 | 114.4 | |
| 163.15 | GRANTHAM | 90½ | 86 | 57 | 115.7 | |
| 168.45 | Stoke | | 89 | 45 | 113.6 | |
| 172.60 | MP96 | | 91 | 44 | 125.5 | |
| 174.60 | MP94 | | 92 | 36 | 138.5 | |
| 176.40 | Little Bytham | | 93 | 22 | 140.9 | |
| 179.60 | MP89 | | 94 | 43 | 142.2 | |
| 183.80 | Tallington | | 96 | 31 | 140.0 | |
| 192.25 | PETERBOROUGH | 105 | 100 | 30 | 127.3 | (4½E) |
| 199.25 | Holme | | 104 | 16 | 111.5 | |
| 209.75 | HUNTINGDON | 114 | 109 | 26 | 121.9 | |
| 216.90 | St Neots | | 112 | 53 | 124.3 | |
| 227.40 | Biggleswade | | 117 | 42 | 130.8 | |
| 236.65 | HITCHIN | 127½ | 121 | 47 | 135.9 | (5½E) |
| 243.55 | Knebworth | | 124 | 59 | 129.4 | |
| 248.30 | Welwyn GC | | 127 | 15 | 125.7 | |
| 255.85 | Potters Bar | 138 | 131 | 03 | 119.2 | |
| 262.15 | New Southgate | | 134 | 13 | 119.4 | |
| 266.10 | Finsbury Park | [1] | 136 | 21 | 111.1 | |
| 268.60 | KING'S CROSS | 149 | 139 | 38 | 45.7 | (9½E) |

144mph was reached at one point. When one looks back at what was done, it is still barely believable. Did we really run up from York pass in 94min 44sec, or average 130.7mph between Huntingdon and Hitchin, or run in from there at 107.4mph pass to stop? Even the Class 91 ac electric *Electra* will be hard put to beat this run in total — a truly one-off occasion that must stand in the record books as the pinnacle of diesel traction performance.

**Table D**
2+8 13.30 King's Cross-Leeds, 26 September 1986

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | KING'S CROSS | 0 | 0 | 00 | | (T) |
| 2.50 | Finsbury Park | | 3 | 39 | 41.1 | |
| 6.45 | New Southgate | | 6 | 19 | 88.9 | |
| 12.75 | Potters Bar | 11 | 10 | 08 | 99.0 | |
| 20.30 | Welwyn GC | | 14 | 22 | 107.0 | |
| 25.05 | Knebworth | [2] | 17 | 05 | 104.9 | |
| 31.95 | HITCHIN | 23½ | 20 | 33 | 119.4 | (3E) |
| 41.20 | Biggleswade | | 25 | 04 | 122.9 | |
| 51.70 | St Neots | | 30 | 13 | 122.3 | |
| 58.85 | HUNTINGDON | 36½ | 33 | 58 | 114.4 | |
| 69.35 | Holme | | 39 | 21 | 117.0 | |
| 75.00 | MP75 | | 42 | 42 | 101.2 | |
| 76.35 | PETERBOROUGH | 48 | 45 | 09 | 33.1 | (3E) |

2+8 08.00 King's Cross-Aberdeen, 3 July 1986

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | STEVENAGE | 0 | 0 | 00 | | (5½L) |
| 4.35 | Hitchin | | 4 | 03 | 64.4 | |
| 13.60 | Biggleswade | | 8 | 34 | 122.9 | |
| 24.10 | St Neots | [2] | 13 | 44 | 121.9 | |
| 31.25 | HUNTINGDON | 19 | 17 | 26 | 115.9 | |
| 41.75 | Holme | | 22 | 43 | 119.2 | |
| 47.40 | MP75 | | 26 | 03 | 101.7 | |
| 48.75 | PETERBOROUGH | 30½ | 28 | 09 | 38.6 | (3L) |

2+8 08.00 King's Cross-Aberdeen, 21 January 1987

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | DONCASTER | 0 | 0 | 00 | | (16½L) |
| 4.30 | Shaftholme | | 3 | 52 | 66.7 | |
| 11.25 | Heck | (1) | 7 | 51 | 104.7 | |
| 18.70 | Hambleton | 12½ | 11 | 30 | 122.5 | |
| 27.00 | Colton | | 15 | 26 | 126.6 | |
| 30.60 | Chaloners Whin | [3] | 17 | 19 | 114.7 | |
| 32.50 | YORK | 25 | 20 | 16 | 38.6 | (12L) |

2+8 12.35 King's Cross-Newcastle, 21 January 1987

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | YORK | 0 | 0 | 00 | | (1E) |
| 3.20 | Skelton Bridge | | 3 | 59 | 48.2 | |
| 9.50 | Tollerton | | 7 | 38 | 103.6 | |
| 15.35 | Pilmoor South | | 10 | 34 | 119.7 | |
| 22.20 | Thirsk | 15 | 13 | 50 | 125.8 | |
| 29.95 | Northallerton | | 17 | 37 | 122.9 | |
| 38.95 | Eryholme | | 21 | 53 | 126.6 | |
| 42.90 | Black Banks | | 24 | 06 | 106.9 | |
| 44.15 | DARLINGTON | 28 | 26 | 14 | 35.2 | (3E) |

Start-to-stop averages:
101.5mph
103.9mph
96.2mph
101.0mph

**Table E**
16.00 King's Cross-Aberdeen, 28 November 1986

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | KING'S CROSS | 0 | 0 | 00 | | (T) |
| 2.50 | Finsbury Park | | 4 | 05 | 36.7 | |
| 6.45 | New Southgate | | 6 | 54 | 84.1 | |
| 12.75 | Potters Bar | 11 | 10 | 43 | 99.0 | |
| 20.30 | Welwyn GC | | 14 | 59 | 106.2 | |
| | | | sigs | | 66.8 | |
| 25.05 | Knebworth | [2] | 19 | 15 | | |
| 31.95 | HITCHIN | 23½ | 23 | 37 | 94.8 | (T |
| | | | tsr | | (30) 73.7 | |
| 41.20 | Biggleswade | | 31 | 09 | | |
| 51.70 | St Neots | | 36 | 27 | 118.9 | |
| 58.85 | HUNTINGDON | 36½ | 40 | 05 | 118.1 | |
| | | | tsr | | (30) 82.2 | |
| 69.35 | Holme | | 47 | 45 | | |
| 76.35 | PETERBOROUGH | 46 | 51 | 39 | 107.7 | (5½L) |
| | | | tsr | | (100) 111.8 | |
| 84.80 | Tallington | | 56 | 11 | | |
| 92.20 | Little Bytham | | 59 | 51 | 121.1 | |
| 100.15 | Stoke | [4] | 63 | 50 | 119.7 | |
| 105.45 | GRANTHAM | 65½ | 66 | 59 | 101.0 | |
| 115.35 | Claypole | | 72 | 18 | 111.7 | |
| 120.15 | NEWARK | 73½ | 74 | 41 | 120.8 | (1L) |
| 126.35 | Carlton | | 78 | 06 | 108.9 | |
| 131.95 | Tuxford | | 80 | 56 | 118.6 | |
| | | | tsr | | (80) 101.9 | |
| 138.60 | RETFORD | 83½ | 84 | 51 | | |
| 147.75 | Bawtry | | 89 | 26 | 119.8 | |
| | | [4] | tsr | | (40) 76.7 | |
| 156.00 | DONCASTER | 96 | 95 | 53 | | (T) |
| 160.30 | Shaftholme | | 98 | 14 | 109.8 | |
| 167.25 | Heck | | 102 | 01 | 110.2 | |
| 174.70 | Hambleton | 106 | 105 | 41 | 121.9 | |
| 183.00 | Colton | | 109 | 45 | 122.5 | |
| 186.60 | Chaloners Whin | [3] | 111 | 52 | 102.0 | |
| 188.50 | YORK | 118½ | 115 | 26 | 32.0 | (3E) |

98.0mph start to stop

More mundane (*Table D*) are the four normal runs but with excellent overall times; two of them were on the same day and without a single check. One fascination in these sprints is whether strategic times like 45min King's Cross-Peterborough or 20min Doncaster-York can be beaten. This latter section has been revolutionised by the Selby diversion opened in October 1983, which brought the net point-to-point time down by 3½min in spite of increasing the distance by 0.35 miles. Even-time (60mph average) was reached in under 4min out of both Stevenage (a straight run), and Doncaster (a loop platform). Even-time in 3min is certainly possible with seven trailers under ideal conditions. The King's Cross-York run (*Table E*) is notable for a good overall time with six checks en route, two of them slight. This exemplifies HST capability to produce a very respectable time in the face of the normal operating vagaries of a run. Conceptually, York was 2½ hours away from London with the Deltic; now it is two hours, the same as Crewe but 30 miles further.

## West of England: now a very fast line

On occasions, people have questioned the justification for keeping an independent InterCity route to the far west; they may well do so again. But in recent times the old Berks & Hants route

**Table F**
2+7 14.48 Penzance-Paddington, 27 July 1985

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | TAUNTON | 0 | 0 | 00 | | (T) |
| | | | | | 45.8 | |
| 2.15 | MP161 | | 2 | 49 | 93.7 | |
| 7.90 | Athelney | | 6 | 30 | 104.0 | |
| 17.20 | Somerton | | 11 | 52 | 102.6 | |
| 22.70 | Keinton M | | 15 | 05 | 99.3 | |
| 27.50 | CASTLE CARY | 21 | 17 | 59 | 95.5 | (3E) |
| 36.25 | Witham | | 23 | 29 | 92.7 | |
| 42.30 | Clink Rd Jct | | 27 | 24 | 88.9 | |
| 48.15 | Heywood Rd Jct | 35 | 31 | 21 | 105.0 | (3½E) |
| 55.85 | Lavington | | 35 | 45 | 104.5 | |
| 63.80 | Woodborough | 45 | 40 | 19 | 107.5 | |
| 72.60 | Savernake | | 45 | 27 | 80.6 | |
| 76.25 | Bedwyn | | 48 | 10 | 92.4 | |
| 81.15 | Hungerford | | 51 | 21 | 99.7 | |
| 89.60 | NEWBURY | 64 | 56 | 26 | 107.2 | (7½E) |
| 96.00 | Midgham | | 60 | 01 | 104.0 | |
| 101.40 | Theale | | 63 | 08 | 87.5 | |
| 104.85 | Southcote Jct | [2] | 65 | 30 | 29.7 | (eased) |
| 106.70 | READING | 79 | 69 | 14 | | (9½E) |

92.5mph start to stop
Athelney-Theale pass to pass:
93.50 miles, 56min 38sec 99.1mph

2+8 14.30 (Fri) Paddington-Penzance 1 August 1986

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | READING | 0 | 0 | 00 | | (8L) |
| | | | | | 41.4 | |
| 1.85 | Southcote Jct | | 2 | 41 | 89.0 | |
| 8.80 | Aldermaston | (1) | 7 | 22 | 100.9 | |
| 17.10 | NEWBURY | 14 | 12 | 18 | 93.9 | |
| 25.55 | Hungerford | | 17 | 42 | 91.9 | |
| 30.45 | Bedwyn | | 20 | 54 | 79.6 | |
| 34.10 | Savernake | | 23 | 39 | 99.6 | |
| 42.90 | Woodborough | 31 | 28 | 57 | 101.1 | |
| 50.85 | Lavington | [3] | 33 | 40 | 99.7 | |
| 58.55 | Heywood Rd Jct | 43 | 38 | 18 | 82.3 | (3½L) |
| 64.60 | Clink Road Jct | | 42 | 34 | | |
| | | | tsr | | (40) 68.5 | |
| 70.45 | Witham | | 47 | 52 | 92.9 | |
| 79.20 | CASTLE CARY | 57 | 53 | 31 | 97.6 | |
| 84.00 | Keinton Mandeville | | 56 | 28 | 100.5 | |
| 89.50 | Somerton | | 59 | 45 | 96.2 | |
| 98.80 | Athelney | [2] | 65 | 33 | 89.7 | |
| 106.70 | TAUNTON | 77 | 70 | 50 | 90.6 | (2L) |
| 113.75 | Wellington | | 75 | 30 | 93.3 | |
| 120.85 | TIVERTON P'WAY | 86 | 80 | 04 | 85.8 | |
| 129.05 | Hele | | 85 | 48 | 88.5 | |
| 136.20 | Cowley Bridge Jct | [2] | 90 | 39 | 39.5 | |
| 137.45 | EXETER ST D | 101 | 92 | 33 | | (½E) |

89.1mph start to stop:

**Table G**
2+8 07.20 Sheffield-St Pancras, 21 September 1986

| *miles* | | *sch* | *min* | *sec* | *mph average* | |
|---|---|---|---|---|---|---|
| 0.00 | DERBY | 0 | 0 | 00 | | (½E) |
| | | | | | 41.9 | |
| 2.55 | Spondon | | 3 | 39 | 78.4 | |
| 6.95 | Sawley Xing | | 7 | 01 | 74.6 | |
| 9.25 | Trent S Jct | | 8 | 52 | 89.7 | |
| 16.85 | LOUGHBR'O | 14 | 13 | 57 | 95.9 | |
| 24.15 | Syston N Jct | | 18 | 31 | 90.6 | |
| 28.15 | Humberstone RJ | [2] | 21 | 10 | 54.7 | |
| 29.35 | LEICESTER | 25½ | 22 | 29 | 39.9 | (3½E) |
| 30.90 | Knighton S Jct | | 24 | 49 | 72.4 | |
| 34.60 | Kilby Bridge | | 27 | 53 | | |
| | | | tsr | | (20) 71.3 | |
| 39.55 | Knebworth | | 32 | 03 | 67.9 | |
| 45.55 | MKT HARBR'O | 38½ | 37 | 21 | 78.5 | |
| 50.35 | Desborough | | 41 | 01 | 85.8 | |
| 56.45 | KETTERING | | 45 | 17 | 90.7 | |
| 63.35 | WELLINGBR'O | 51 | 49 | 51 | 87.9 | |
| 71.85 | Sharnbrook | [2] | 55 | 39 | 102.6 | |
| 78.55 | BEDFORD | 63 | 59 | 34 | 101.6 | (4E) |
| 85.80 | Ampthill TNE | | 63 | 51 | 103.0 | |
| 91.15 | Harlington | | 66 | 58 | 101.1 | |
| 98.20 | LUTON | 75 | 71 | 09 | 94.6 | |
| 103.80 | Harpenden | [2] | 74 | 42 | 97.2 | |
| 108.55 | ST ALBANS | 83½ | 77 | 38 | 100.8 | |
| 116.00 | Elstree | | 82 | 04 | 103.7 | |
| 121.50 | Hendon | | 85 | 15 | | |
| | | | tsr | | (40) 73.0 | |
| 126.85 | Kentish Town | [3] | 89 | 39 | 33.1 | |
| 128.45 | ST PANCRAS | 102 | 92 | 33 | | (10E) |

83.3mph start to stop

has been transformed. Witness the 92.5mph start to stop run between Taunton and Reading (*Table F*), inconceivable a few years ago when the line limit was 90mph. This run was with seven trailers, but what is the difference with 2+8 — almost nothing! The Reading-Exeter run was very little slower, after allowing for the temporary speed restrictions. In fact, the point-to-point times do not show any difference with an extra vehicle, though 1986/87 schedules contained up to a 4min hidden reserve, with consequent heavy gains in day-to-day running. Note that overall time (92min 33sec) is identical with the Derby-St Pancras run discussed later. But Reading-Exeter is nine miles longer. This illustrates the present day quality of a route that was strung together in the first place from three branch lines, with three cut offs and the two avoiding lines at Westbury and Frome.

## Midland: a HST afterthought

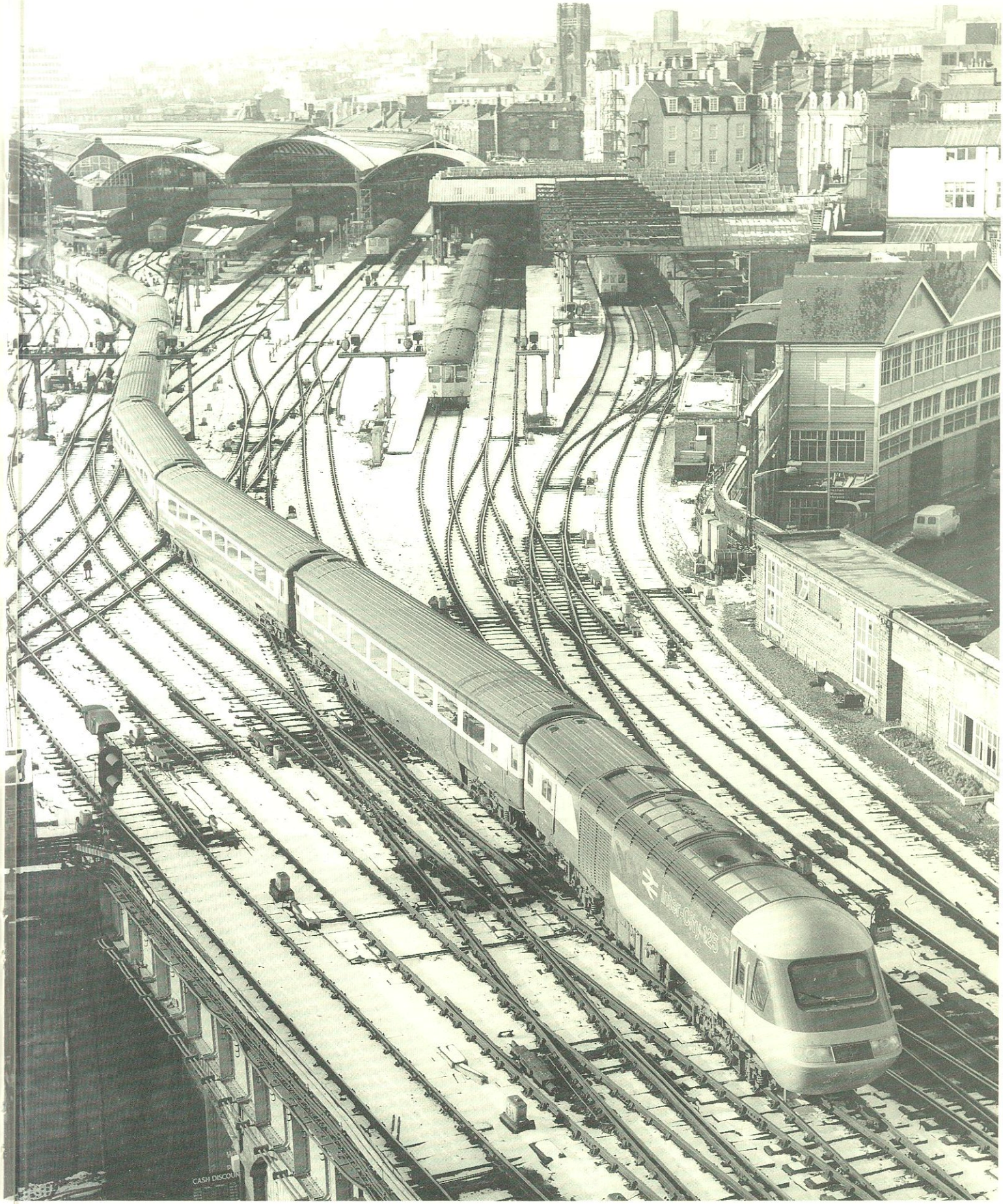
Seeing the sparkling performance now given by the HSTs, it is hard to imagine the Midland being left out of the original programme. A representative journey would be a semi-fast, calling at Wellingborough, Kettering, Leicester and Loughborough, if not other points. However, the up 'Master Cutler' Pullman from May 1987 but otherwise unchanged (*Table G*), gives the unique opportunity of passing through Leicester non-stop, albeit still at a pathetic 15mph over the London end curves. Running was very gentle indeed out of Derby and unexceptional until Kettering. Then, for some reason, the driver 'let rip' in spite of being 4min early at Bedford (an SNCF driver would have conserved both fuel and path in such a situation). The 100mph limit was exceeded by up to about 5mph, but this can be regarded as just within tolerance. As a result, Sharnbrook to Hendon, almost 50 miles, was covered in 29min 30sec (the exact average being 100.6mph). A fitting conclusion to this collection of HST logs.

*Right:*
Flat-out near West Drayton is an unidentified HST unit on a down express on 13 June 1987.
*Brian Morrison*

*Below right:*
An interesting pre-electrification view of the southern approach to Doncaster station in March 1986. A HST slows for the stop.
*Peter Marsh*

*Bottom right:*
The Berks & Hants line has enjoyed line speed improvements since the resignalling of the late 1970s and now features some 110mph sections. In this view unit No 253.041 hurries along one such section near Midgham Lock with the 09.25 Plymouth-Paddington.
*Brian Morrison*

*Far right:*
On a crew-training run in the February snow of 1978, HST No 254.010 winds it way out of Newcastle station.
*Peter J. Robinson*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CHAPTER TEN

# Into The 1990s

Electrification of the East Coast main line and the deployment of the IC125 fleet were interlinked from the start. An important element in the case for electrification was the subsequent impact of the released HST sets on the BR rolling stock cascade.

Before creation of the Sectors in 1982, main line coaches were deployed on the basis of 'earnings per coach'. New stock was allocated to the most profitable routes, displacing older vehicles which would upgrade quality on the next service in this profitability ranking. At one stage it was intended to cascade the 34 HST sets released by the ECML electrification to what was then known as the 'Secondary Inter-City Network', which included the Edinburgh-Glasgow, Glasgow/Edinburgh-Aberdeen, North Trans-Pennine and London (Waterloo)-Exeter routes.

The former services became part of the Provincial Sector. With an expansionist commercial policy based on a growing fleet of new-generation Sprinter DMUs which, at the top of the range, are intended to match the air-conditioned ambience of HST but with much lower operating costs and greater flexibility, Provincial was no longer interested in cascaded InterCity hardware.

In the case of Waterloo-Exeter, there was initial interest from Network SouthEast. On the long, singled main line, the extra acceleration of a cut-down 2+6 HST, possibly enhanced by regearing for 100mph, would have reduced journey times and increased line capacity. Twin power cars would also have improved reliability compared with the ageing diesels employed on the route.

Unfortunately, in a straight financial analysis, a 1+5 HST emerged as the favoured option, favoured, that is, by the Department of Transport. This reflected the cost of maintaining the highly-rated power equipment which made HST possible. With the Sprinter programme having rehabilitated the classic DMU concept, Network SouthEast took the same route with 'Networker Turbo'.

In retrospect, this was fortunate. InterCity was finally starting to appreciate the unique virtues of HST, to the extent that in 1988 Sector Director Dr John Prideaux described HST as 'an outstanding achievement, fully the equal of TGV' (the French Railways Train à Grande Vitesse). Thus, although at the time of writing full ECML electrification was three years away, it was clear that the HST cascade would keep all of this now-precious resource within the InterCity Sector.

Cutover from HST to electric traction on the East Coast route is taking place in three phases. Originally, it was planned that the full electric service to Leeds would start in 1989. However, with electrification itself running ahead of schedule and GEC starting deliveries of the Class 91 electric locomotives in February 1988, it was decided to bring forward the Leeds service by a full 12 months.

Because the Mk 4 coaches for the ECML electrified service had been ordered after the Class 91 locomotives, and around five months was then lost as a result of a change in bogie design, delivery of the new vehicles would not start until April 1989. To fill this rolling stock gap, 10 HST sets were converted to push-pull operation with Class 91 motive power.

This involved removing one power car and turning the other into a 'surrogate DVT' (Driving Van Trailer). Externally, the main difference was the addition of buffers to the retained power car. Internally, a new multiplexing remote control system, transmitting signals over the existing train wires, allowed a 'pushing' Class 91 to be driven from the HST cab.

Because of the incompatibility between the Class 91 auxiliary power supply and the HST trailer cars, power for the train continued to be supplied by the engine of the surrogate DVT. There was considerable debate over whether the traction motor brushes of the HST should be removed. Extended running without power can cause commutator glazing, leading to flashover when power is applied. In the event, it was decided that the option to run under diesel power would be retained and the brushes left in place.

Of the 10 conversions to DVT, the first two were carried out at the Mechanical & Electrical Engineering Department's Engineering Development Unit (EDU) at Derby and the remainder at

Stratford Depot. As the Mk 4 coaches were commissioned during 1989, they would replace the HST DVT sets, until the 10 Class 91/Mk 4 formations took over London-Leeds electric services in October 1989, releasing seven HST sets for redeployment.

With the full cut-over to electric traction on the ECML in May 1991, a further 27 HSTs will be released. The remainder of this chapter analyses a number of the redeployment options currently being studied. None of these are mutually exclusive.

**(1)** Business growth along the Paddington-Swindon-Bristol/South Wales corridor is continuing to tax the Great Western sub-Sector's resources. To cope with this growth an extra set may be transferred across to the Great Western main line for the May 1989 timetable, together with sufficient trailer vehicles to bring the 21 2+7 sets up to a 2+8 configuration. In anticipation, the 1989-90 Great Western timetable is being drafted on 2+8 timings for all services. This strengthening would provide an extra 648 seats on the morning 15min interval peak service from Swindon to Paddington.

**(2)** Some of the HSTs released from the East Coast route in 1989 could be moved to the Cross Country axis. They would replace locomotive-hauled services between Newcastle, Liverpool, Manchester and Poole. Services from Liverpool and Manchester are electrically hauled as far as Birmingham (New Street) or Coventry, from where Class 47 diesels take over for the journey through Oxford, Reading (reverse), Basingstoke, Southampton and Bournemouth. Class 47s are also used for the Newcastle-Poole service but locomotives have to be changed when the train reverses in Birmingham. The Class 47s are now over 25 years old and are expensive to maintain. Their fuel consumption is high and early withdrawal is an InterCity priority.

Fixed-formation HSTs are the ideal tool for these long Cross-Country journeys and would eliminate the need for locomotive-changing, both at Birmingham and Reading. On the Newcastle-Poole service HSTs will be able to run at 125mph between Newcastle and Doncaster; 100mph will be their maximum speed over other parts of this route. Whether or not BR will ever upgrade parts of the West Coast main line for 125mph remains to be seen, but as the Liverpool and Manchester trains cover only a short section of the route with upgrading capability the issue is probably academic. Because of their superior acceleration and braking characteristics HSTs will make a significant journey time reduction on the Poole route. The route between Basingstoke and Poole has already been cleared for 23m Mk 3 stock for the new Bournemouth line Class 442 EMUs.

**(3)** It is quite likely that five or so HSTs will remain on the East Coast after May 1991 based at Neville Hill. Extension of East Coast IC125 Services into ScotRail territory has been very successful but, with electrification, a change of traction from electric to diesel will be necessary at Edinburgh. If the new Mk 4 stock goes beyond Edinburgh it will need high-power traction if post-electrification journey time reductions south of Edinburgh are not to be off-set by slower times to the north. InterCity is thus looking at the possibility of using two HST power cars to haul Mk 4 stock to Aberdeen or Inverness.

Another problem post-1991 is the provision of through services from King's Cross to Cleethorpes, Hull and Middlesbrough. If Mk 4 stock is used, traction changes would have to be made at Newark, Doncaster and York, requiring Class 91 locomotives to be positioned at these changeover points for the start of each day. Instead HSTs are likely to be the preferred option for these services. This option is even more attractive if diagrams can be devised which can combine Inverness and Aberdeen with Cleethorpes, Hull and Middlesbrough.

**(4)** Cross-Country InterCity services are provided by a combination of HSTs and sets of Mk 2 stock hauled by Class 47 locomotives. This hauled stock will be replaced, but not necessarily with a full 2+7 HST set. Given that the potential line speed over the core section of the route is at best 90/100mph, trains between York and Bristol could be provided by a shortened HST with one power car and four or five trailers in 'push-pull' mode. This would reduce fuel consumption and maintenance costs to a considerable extent.

**(5)** A final option is to disband the remaining sets for use as separate conventional locomotives and coaches. Depending on the cost of modifications, HST power cars could be converted to locomotives to replace ageing Class 47s. The trailer rakes would be modified to work as fixed formation sets in push-pull mode between Euston, Birmingham and Wolverhampton with Class 87 or 90 electric locomotives offering a potential maximum speed of 110mph.

*Far left:*
The WCML at Kenton is the setting for DVT No 43123 bringing up the rear of a Stonebridge Park-Rugby test working on 20 November 1987.
*Brian Morrison*

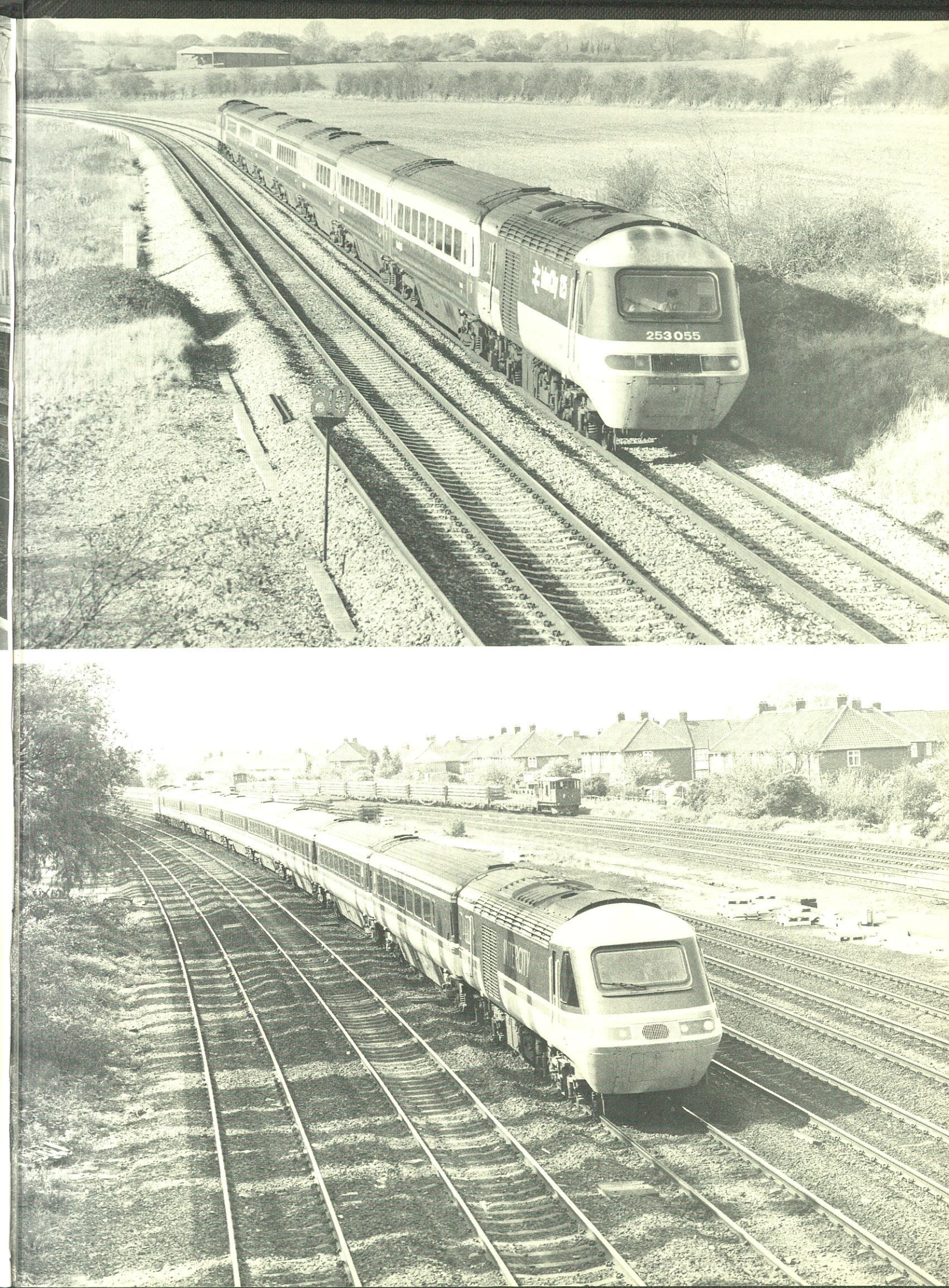
*Left:*
Later the same day, No 43123 is seen having arrived at Rugby. Note the provision of external buffers and drawgear in place of the lower nose fairing.
*A. O. Wynn*

*Above:*
DVT No 43014 pauses at Stafford with a test train of Mk 2 Stock on 7 December 1987. Motive power on this occasion was provided by Class 86/2 No 86228. *T. R. Moors*

*Left:*
HST power car No 43084 *County of Derbyshire* is seen undergoing DVT conversion at Stratford Major Depot on 2 March 1988. *Brian Morrison*

*Above right:*
By mid-1988 most Mk 3 stock for HST services had been refurbished but formations such as this one, seen on the West of England main line, were still common. *D. E. Canning*

*Right:*
With overhead wiring equipment still to be erected, an HST set displays the latest InterCity 'Swallow' livery as it passes Holgate Bridge, south of York, while working the 09.00 King's Cross to Edinburgh on 14 May 1988. *W. A. Sharman*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# Appendix

**Permanent Speed Restrictions on selected HST routes**

The sections of lines in the following help to clarify HST performance logs in *Chapter 9*. Minor speed improvements are happening all the time, of course; this was the position as at mid-1987. Figures marked against each change of speed are milepost mileages; associated place names are shown where relevant.

## READING-EXETER

| | | |
|---|---|---|
| 80 | 35.8 | READING |
| | 36.2 | |
| 40 | | |
| | 36.3 | |
| 50 | | |
| | 36.9 | Southcote Jct |
| 60 | | |
| | 38.3 | |
| 100 | | |
| | 46.6 | Midgham |
| 95 | | |
| | 47.1 | |
| 100 | | |
| | 51.5 | Bulls Lock |
| 110 | 53.1 | NEWBURY |
| | 58.6 | Kintbury |
| 90 | | |
| | 61.5 | Hungerford |
| 75 | | |
| | 62.0 | |
| 90 | | |
| | 64.1 | |
| 100 | | |
| | 68.1 | Crofton |
| 70 | | |
| | 68.6 | Grafton |
| 80 | | |
| | 69.5 | |
| 90 | | |
| | 70.7 | Savernake |
| 100 | | |
| | 76.1 | PEWSEY |
| 110 | | |
| | 83.3 | Crookwood |
| 100 | | |
| | 85.0 | |
| 90 | | |
| | 85.5 | |
| 100 | | |
| | 86.5 | Lavington |
| 110 | | |
| | 94.6 | Westbury AL |
| 80 | | |
| | 97.0 | |
| | 111.2 | |
| 100 | | |
| | 114.5 | Frome AL |
| 80 | | |
| | 116.5 | |
| | 116.7 | |
| 100 | | |
| | 121.0 | Witham |
| ↑ 100 90 ↓ | | |
| | 123.5 | |
| 90 | | |
| | 125.5 | Sheephouse |
| 100 | | |
| | 129.4 | |
| 90 | | |
| | 130.2 | |
| ↑ 100 90 ↓ | 116.0 | CASTLE CARY |
| | 116.6 | |
| 100 | | |
| | 126.8 | Somerton Tunnel |
| ↑ 100 90 ↓ | | |
| | 129.5 | Langport |
| 100 | | |
| | 137.8 | Athelney |
| 90 | | |
| | 138.0 | |
| ↑ 100 90 ↓ | 158.3 | Cogload Up Jct |
| | 158.6 | |
| 100 | 163.1 | TAUNTON |
| | 177.3 | TIVERTON PARKWAY |
| | 182.3 | Cullompton |
| 90 | | |
| | 183.1 | |
| ↑ 100 90 ↓ | | |
| | 185.5 | Hele |
| 100 | | |
| | 191.5 | |
| 90 | | |
| | 192.1 | |
| ↑ 90 75 ↓ | | |
| | 192.6 | Cowley Br Jct |
| ↑ 55 60 ↓ | | |
| | 192.8 | |
| 70 | | |
| | 193.6 | |
| ↑ 50 30 ↓ | | |
| | 193.9 | EXETER |

## KING'S CROSS-NEWCASTLE

| | | |
|---|---|---|
| | 0.0 | KING'S CROSS |
| 15 | | |
| | 0.4 | |
| 45 | | |
| | 0.8 | |
| 65 | | |
| | 1.5 | Holloway |
| 80 | | |
| | 2.8 | |
| ↑85 80↓ | | |
| | 3.4 | Harringay |
| ↑95 80↓ | | |
| | 4.5 | |
| 95 | | |
| | 5.9 | Wood Green Tunnel |
| 100 | | |
| | 7.9 | |
| ↑ 100 105 ↓ | | |
| | 12.0 | Potters Bar |
| 105 | | |
| | 18.9 | |
| 115 | | |
| | 22.1 | Welwyn Tunnels |
| 105 | | |
| | 23.2 | |
| 125 | 27.6 | STEVENAGE |
| | 54.6 | Offord |
| 110 | | |
| | 56.2 | |
| 125 | 58.9 | HUNTINGDON |
| | 69.4 | Holme |
| 105 | | |
| | 71.3 | |
| 115 | | |
| | 75.3 | |
| 105 | | |
| | 76.4 | PETERBOROUGH |
| 115 | | |
| | 78.1 | |
| 125 | | |
| | 100.5 | Stoke Tunnel |
| 115 | | |
| | 101.0 | Highdyke |
| ↑ 100 105 ↓ | | |
| | 101.6 | |
| 100 | | |
| | 105.5 | GRANTHAM |
| 115 | | |
| | 109.2 | Barkston |
| 100 | | |
| | 110.0 | |

| | | |
|---|---|---|
| | 110.0 | |
| 125 | | |
| | 120.1 | NEWARK |
| | 120.8 | Newark Crossing |
| 100 | | |
| | 121.0 | |
| 125 | | |
| | 130.5 | Egmanton |
| 115 | | |
| | 131.6 | |
| 125 | | |
| | 132.6 | |
| 115 | | |
| | 138.8 | RETFORD |
| 125 | | |
| | 146.9 | Bawtry |
| 110 | | |
| | 148.5 | |
| 125 | | |
| | 154.5 | Decoy |
| 120 | | |
| | 155.3 | |
| ↑ 120 100 ↓ | | |
| | 155.7 | |
| 100 | 44.1 | DONCASTER |
| | 156.7 | |
| 105 | | |
| | 157.0 | |
| 125 | | |
| | 160.0 | Shaftholme |
| ↑ 125 100 ↓ | | |
| | 160.4 | |
| 125 | | |
| | 186.3 | Chaloners Whin |
| 100 | | |
| | 186.5 | |
| 90 | | |
| | 188.0 | Holgate |
| | 188.5 | YORK |
| 25 | 0.0 | |
| | 0.5 | |
| 50 | | |
| | 1.1 | York Yard N |
| 125 | | |
| | 40.1 | Croft Spa |
| 110 | | |
| | 41.6 | |
| 125 | | |
| | 43.7 | |
| 90 | | DARLINGTON |
| | 45.0 | |
| 125 | | |
| | 48.0 | |
| 85 | | |
| | 48.6 | Aycliffe |

| | | |
|---|---|---|
| | 48.6 | Aycliffe |
| 80 | | |
| | 49.4 | |
| 105 | | |
| | 56.2 | Ferryhill |
| 110 | | |
| | 59.8 | Hett Mill |
| ↑ 100 110 ↓ | | |
| | 60.6 | |
| 95 | | |
| | 62.3 | Croxdale |
| 85 | | |
| | 63.0 | |
| 95 | | |
| | 64.6 | Bridge House |
| ↑ 80 75 ↓ | | |
| | 65.8 | |
| 75 | | |
| | 66.3 | DURHAM |
| 85 | | |
| | 68.4 | Newtonhall |
| 105 | | |
| | 68.5 | |
| | 71.9 | Chester le Street |
| 100 | | |
| | 72.3 | |
| 110 | | |
| | 75.0 | |
| ↑ 110 100 ↓ | | |
| | 77.0 | |
| 100 | | |
| | 78.5 | |
| ↑ 100 95 ↓ | | |
| | 78.8 | |
| 70 | | |
| | 79.0 | Bensham |
| 60 | | |
| | 79.3 | |
| 50 | | |
| | 79.4 | KEB Jct |
| 25 | | |
| | 79.9 | |
| 15 | | |
| | 80.2 | NEWCASTLE |

## ST PANCRAS-DERBY

| | | |
|---|---|---|
| | 0.0 | ST PANCRAS |
| 10 | | |
| | 0.3 | |
| ↑ 50 40 ↓ | | |
| | 0.6 | North London |
| 50 | | |
| | 1.2 | Camden Rd |

| | | |
|---|---|---|
| | 1.2 | Camden Rd |
| 70 | | |
| | 2.0 | |
| 75 | | |
| | 2.3 | Haverstock Hill |
| 80 | | |
| | 3.5 | |
| 85 | | |
| | 5.3 | Cricklewood |
| 100 | | |
| | 19.8 | St Albans |
| ↑ 100 95 ↓ | | |
| | 20.0 | |
| 100 | | |
| | 28.0 | |
| 85 | | |
| | 30.3 | LUTON |
| 100 | | |
| | 49.9 | BEDFORD |
| | 64.3 | |
| 65 | | |
| | 65.1 | WELLINGBOROUGH |
| | 65.3 | |
| 90 | | |
| | 66.3 | Neilsons |
| 100 | | |
| | 71.0 | Kettering Jct |
| 90 | | |
| | 72.3 | KETTERING |
| 85 | | |
| | 72.5 | |
| 90 | | |
| | 73.0 | |
| 100 | | |
| | 74.6 | |
| 90 | | |
| | 75.8 | Glendon |
| ↑ 90 100 ↓ | | |
| | 76.4 | Gaultney Wood |
| 100 | | |
| | 82.0 | Little Bowden |
| ↑ 75 100 ↓ | | |
| | 82.8 | MARKET HARBOROUGH |
| 60 | | |
| | 83.1 | |
| 85 | | |
| | 84.3 | Gt Bowden |
| 100 | | |
| | 92.4 | Newton |
| 95 | | |
| | 92.6 | |
| 100 | | |
| | 95.6 | Wigston North |
| 80 | | |
| | 95.9 | |
| 100 | | |
| | 97.2 | Aylestone |
| 90 | | |
| | 98.4 | Cattle Market |

| | | |
|---|---|---|
| | 98.4 | Cattle Market |
| 50 | | |
| | 98.9 | London Rd Jct |
| 15 | | |
| | 99.0 | |
| 40 | 99.1 | LEICESTER |
| | 99.2 | |
| ↑ 90 100 ↓ | | |
| | 102.5 | |
| 90 | | |
| | 102.7 | |
| ↑ 95 90 ↓ | | |
| | 104.3 | Syston North |
| 90 | | |
| | 104.6 | |
| ↑ 95 90 ↓ | | |
| | 109.0 | Barrow on Soar |
| 100 | 111.6 | LOUGHBOROUGH |
| | 114.8 | Hathern |
| 90 | | |
| | 115.4 | |
| 100 | | |
| | 118.3 | Ratcliffe Jct |
| 90 | | |
| | 119.2 | Trent South Jct |
| 70 | | |
| | 119.8 | LONG EATON |
| 80 | | |
| | 128.2 | |
| 15 | 127.6 | |
| | 127.9 | DERBY |

## SWINDON-BRISTOL (VIA BOX)

| | | |
|---|---|---|
| | 76.3 | SWINDON |
| 100 | | |
| | 77.8 | |
| 125 | 94.0 | CHIPPENHAM |
| | 98.8 | Box Tunnel |
| 100 | | |
| | 105.5 | Hampton Row |
| 75 | | |
| | 106.8 | BATH SPA |
| 30 | | |
| | 107.0 | |
| 90 | | |
| | 108.3 | Twerton |
| 100 | | |
| | 114.3 | Fox's Wood |
| ↑ 90 100 ↓ | | |
| | 115.7 | |
| 90 | | |
| | 117.9 | Bristol East |
| 25 | | |
| | 118.4 | BRISTOL TM |

## PADDINGTON-BRISTOL (VIA HULLAVINGTON)

| | | |
|---|---|---|
| | 0.1 | PADDINGTON |
| 25 | | |
| | 0.6 | |
| 60 | | |
| | 1.0 | Subway Jct |
| ↑ 60 100 ↓ | | |
| | 1.6 | |
| 100 | | |
| | 4.5 | Acton Yard |
| 125 | 18.4 | SLOUGH |
| | 35.8 | READING |
| 80 | | |
| | 36.4 | |
| 125 | | |
| | 44.0 | |
| ↑ 120 125 ↓ | | |
| | 49.3 | Cholsey |
| 125 | 53.1 | DIDCOT |
| | 76.3 | SWINDON |
| 100 | | |
| | 77.8 | |
| 125 | | |
| | 83.1 | Wootton Bassett Jct |
| 70 | | |
| | 83.3 | |
| 100 | | |
| | 83.8 | |
| 110 | | |
| | 86.8 | Brinkworth |
| 125 | | |
| | 97.4 | Alderton Tunnel |
| 110 | | |
| | 97.8 | |
| 125 | | |
| | 101.1 | Sodbury Tunnel |
| 120 | | |
| | 104.8 | |
| 110 | | |
| | 107.0 | Westerleigh Jct |
| 100 | | |
| | 107.3 | |
| ↑ 100 125 ↓ | | |
| | 111.9 | BRISTOL PARKWAY |
| 60 | 112.8 | |
| | 4.8 | Filton Jct |
| 70 | | |
| | 4.4 | |
| 75 | | |
| | 2.9 | Ashley Hill |
| 60 | | |
| | 0.8 | Dr Days Jct |
| 40 | | |
| | 0.4 | |
| 25 | 118.0 | Bristol East |
| | 118.4 | BRISTOL TM |

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